A STUDY OF THE DESIGN AND CONSTRUCTION OF BUILDINGS IN THE POMBALINE QUARTER OF LISBON.

A dissertation submitted by

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DECLARATION

I declare that, this thesis is the result of my own studies, it has not been accepted for any other award or degree and is not concurrently being submitted in candidature for any other award or degree.

Signed:.....Jorge Marcarenhas.....

Date:.....08/07/96.....

Aerial view of the Pombaline Quarter of Lisbon.

CONTENTS

Abstract

In the year 1755, the lower part of the city of Lisbon was hit by a severe earthquake. Immediately following the earthquake a complex reconstruction process began, which introduced new urban, architectural and constructional concepts. This resulted in the creation of new innovative rentable buildings termed the Pombaline rentable buildings, after the Marquis of Pombal who directed their construction.

This thesis comprises a wide ranging and detailed study of these buildings.

At the beginning of this work, in Chapter I, "The Pombaline rentable building" is placed in its historical context. The origins of the old city are described and its historical development within Portugal. The results and consequences of the 1755 earthquake are outlined, and the subsequent process of reconstruction is described. All immediate measures, decrees, and proposals for the reconstruction of the city, plus Manuel da Maia's Dissertations, are carefully compared and analysed, as are the various plans proposed for the reconstruction.

The preceding periods of Portuguese Architecture are studied to identify possible origins for the architecture of the Pombaline rentable buildings. Also a clear definition of the Pombaline Rentable building and the limits of the genuine Pombaline area are established.

In Chapter II the general methodology used in the research is described, which includes a survey of 315 buildings and a documentary search for material relating to the construction of the buildings.

In Chapter III an analysis is made of the general external and internal architectural characteristics of the rentable buildings. An extensive search for original drawings, produced drawings only of the elevations of the main streets. These are carefully analysed and compared with existing buildings and a classification system is developed. A complete survey by the author of the buildings` interiors, for which no documentary information exists, reveals a great complexity and variety of interior plans. To achieve a systematic classification of the interiors particular aspects are analysed including, the types of stairs, the organization of the interior spaces, the building location and the finishing details.

Chapter IV describes some of the technical innovations shown by the rentable buildings, particularly those referring to earthquake resistance in construction and to prefabrication. During the survey of plans and elevations the Author identifies evidence for the existence of prefabrication, in terms of sizes of components, tolerances and detailing. This evidence is supported indirectly by documentary material although the extent of documentation is very limited.

Possible evidence for an evolutionary development in the internal plan and design of the buildings based upon the position of stairs in the buildings is presented in Chapter V. An attempt is made to relate this classification to the dates of construction of the different buildings. This is achieved by an analysis of previous tax records which enable numbers of buildings constructed on different streets at different periods to be determined. Based on this analysis the evidence for an evolutionary development is discussed.

In Chapter VI the Pombaline rentable buildings of Lisbon are compared with other contemporary developments at Porto Côvo, Vila Real and Manique do Intendente in order to assess the influence of the Pombaline development, both in terms of the architecture and the construction processes, on other construction projects outside Lisbon.

Chapter VII discusses the principal findings of the research and their importance in the context of Portuguese architecture.

Acknowledgements

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Glossary

Alfugere-courtyard between buildings
Cêrca - city walls
Gaiola-cage, wooden structure providing earthquake resistance.
Palmo - palm = 22.5 cm
Praça - square
Rio - river
Rua - street
Saguão-Courtyard inside a building

Names

Casa do Risco - School of Building and Architecture
Marquês de Pombal-Marquis of Pombal
Rua da Prata - Silver Street
Rua do Ouro - Gold Street
Rua dos Sapateiros - Shoemakers` Street
Rua dos Douradores - Gilders` Street
Rua dos Fanqueiros - Drapers` Street
Rua dos Retroseiros - Haberdashers` Street

Before 1755	After 1755
Terreiro do Paço	Praça do Comércio
Title	**Real Name**
Marquês de Pombal	Sebasteão José Carvalho e Melo.

Pombaline Rentable Building
Built by private owners for habitation, ground floor occupied by commerce or industry

Pombaline area —·—·—
Limits for this study, where are located the genuine Pombaline rentable buildings

Transition areas ·····
Buildings similar to the Pombaline rentable buildings, built later than those of the reconstruction, and without the rigid restrictions of the Pombaline area.

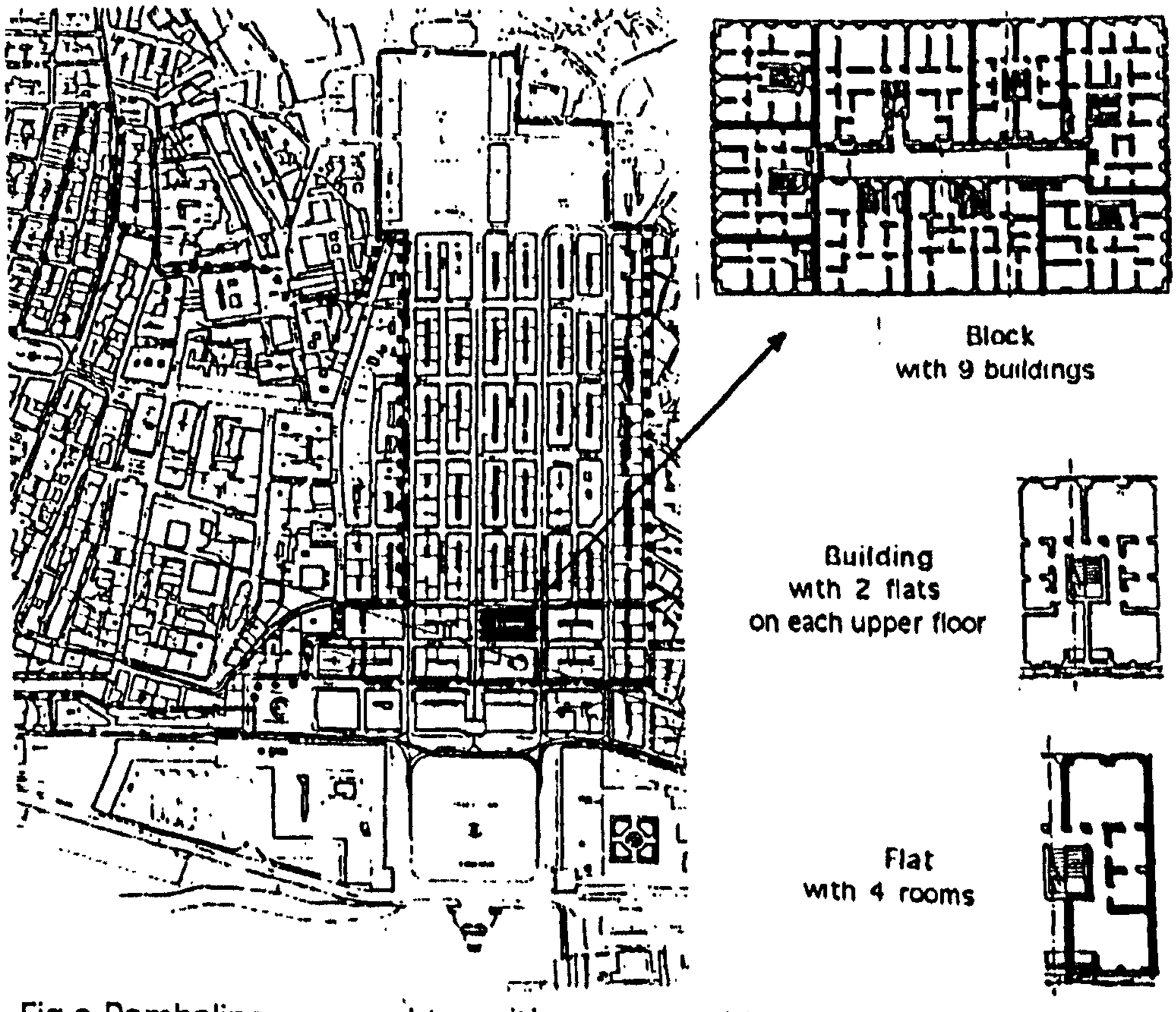

Fig.a-Pombaline area and transition areas, a block, a building and a flat.

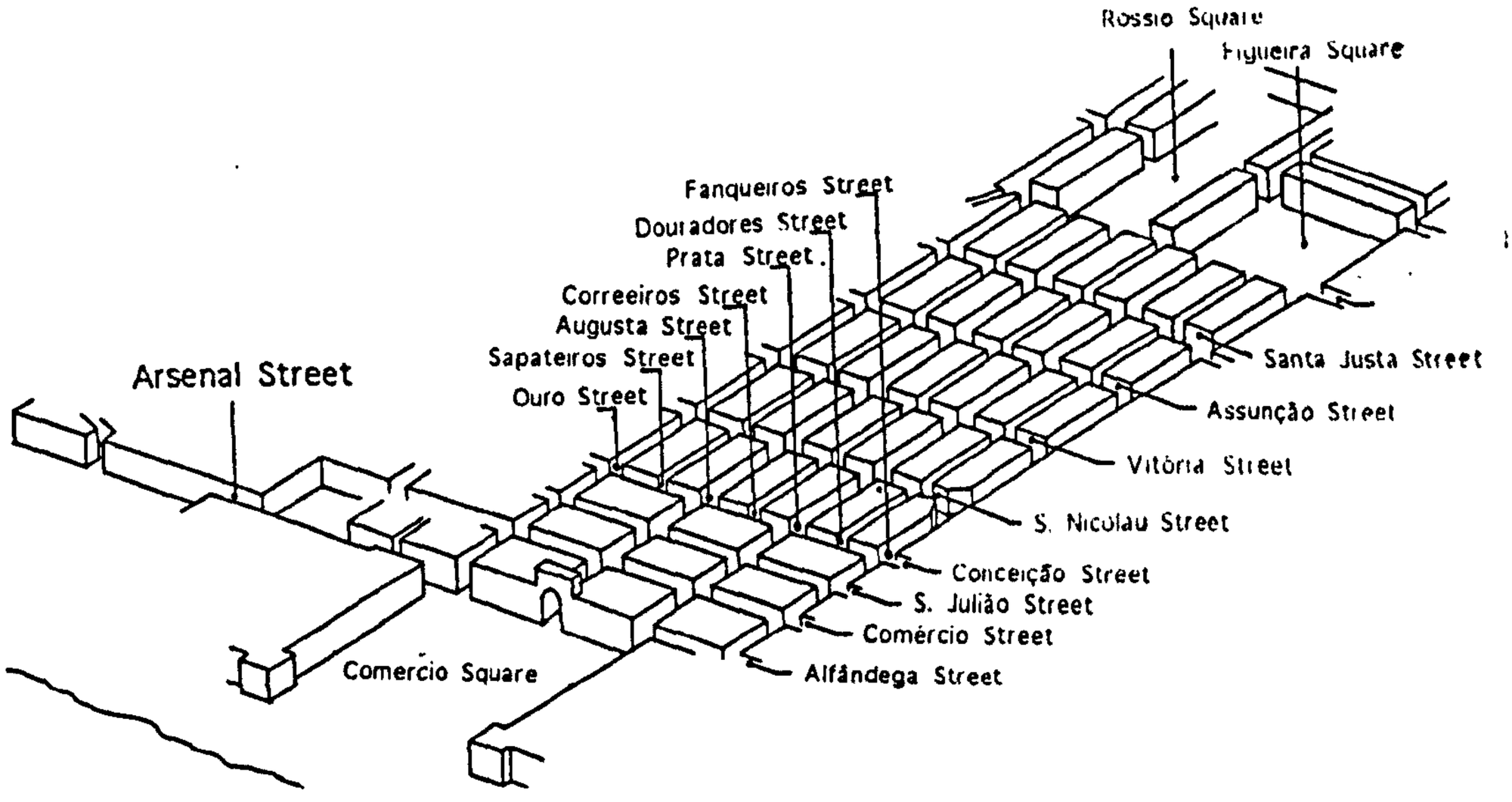

Fig.b-Identification of streets and squares.

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I. THE HISTORICAL AND ARCHITECTURAL BACKGROUND TO THE POMBALINE RENTABLE BUILDING

I.1. The context and aims of the current project.

In the year 1755, the lower part of the city of Lisbon was hit by a severe earthquake and consumed immediately afterwards by a fire which lasted several days.

A complex reconstruction process directed by the then Prime Minister, the Marquis of Pombal, began immediately. It was an extensive, unique undertaking that was ahead of its time(1).

With it began a new urban, architectonic and constructive mentality which would produce a specific style of rentable building, with important innovations at both an architectural and constructional level (see Fig.1)(2).

This work seeks to study the architectural and constructional aspects of the Pombaline rentable buildings in detail in order that a better knowledge of them will lead to their conservation.

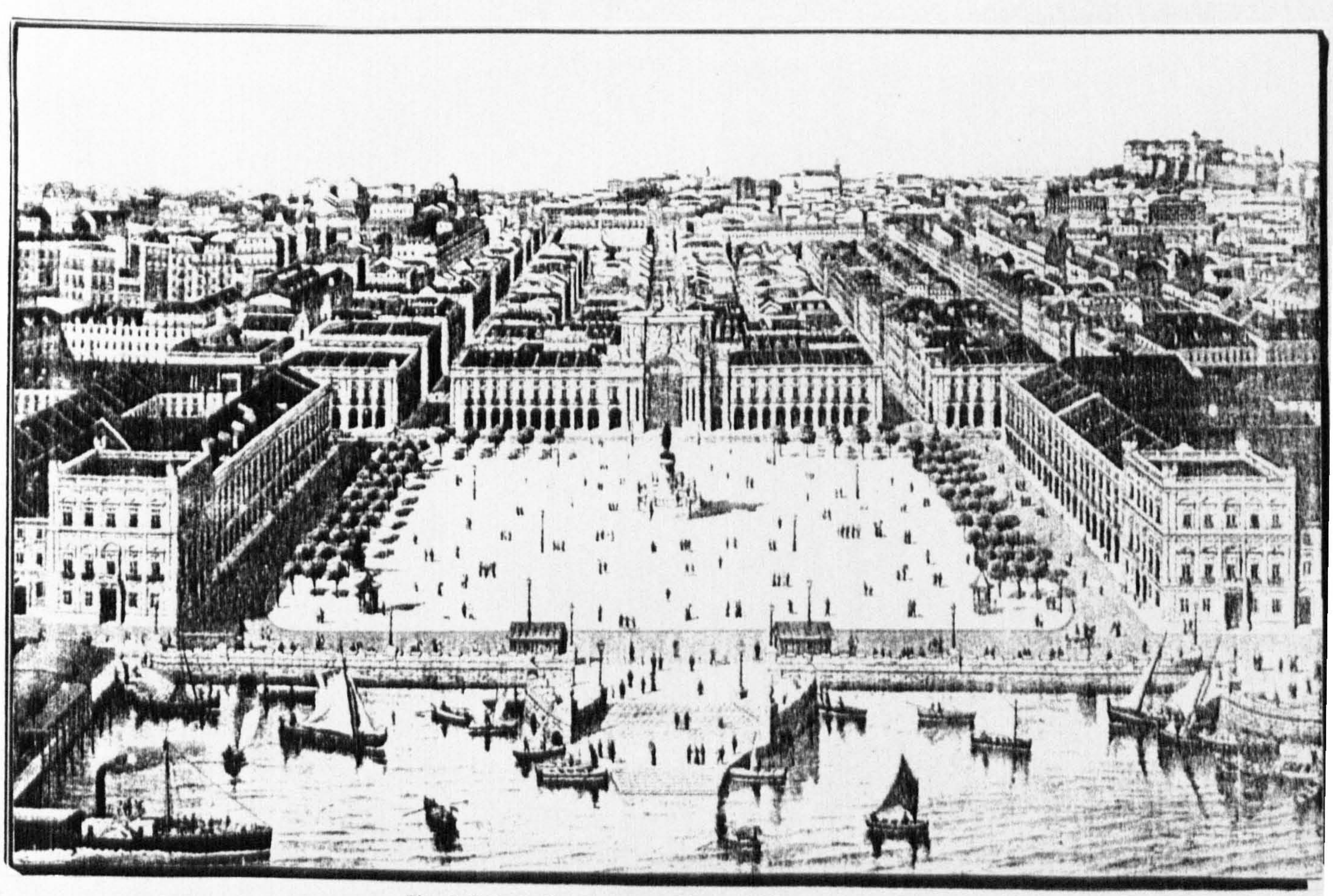


Fig.1-Pombaline quarter (end of XIX century).

The principal aims of the study are:

i)To determine the origins of the Pombaline rentable building.

ii)To identify the principal distinguishing characteristics of the Pombaline rentable buildings with particular reference to earthquake resistance and form of construction, and to determine the extent of technical innovation, standardisation, dimensional co-ordination and pre-fabrication in the construction of the buildings.

iii)To analyse the internal layouts of the buildings and determine whether these represent an evolutionary sequence.

iv)To relate the Pombaline rentable buildings to preceding, contemporary and subsequent styles of Portuguese architecture, and to determine whether there is, at a constructional and architectural level, sufficient evidence to classify the Pombaline rentable building as an identifiable style of Portuguese architecture.

I.2. The settlement and historical development of the centre of Lisbon.

The complex system of construction of the Pombaline buildings was a consequence (see Fig.2), of the characteristics of the ground conditions of the lower part of the city. It is important in approaching this subject to take account of the formation of the enormous alluvium upon which the lower part of the city was founded(3).

The lower part of the city was in a small creek which was the result of the action of two water courses; the streams of S. Sebastião da Pedreira and of Arroios. During prehistory they converged into a generous valley that separated two hills, those of S. Roque and Castelo. An immense Miocene rock-bed had been eroded by the two streams to form the valley.

Before the rock-bed silted up, this place situated on the vast Tagus estuary, offered excellent conditions for settlement. The river was navigable far above the river mouth and down-stream it opened widely into the sea. The abundance of fish, fresh water and arable soil made conditions ideal to set up a hamlet. The defence of the site was also possible. The hill where the Castle presently stands with its steep slopes formed a huge cone which blocked access from either the north or the west and made any attempts to besiege it a difficult task. The other sides descend into water(4).

This rock-bed was slowly but successively silted up by sands lodged by the river current, by the constant collapse of the slopes due to the action of the rain, or by light earth movements which expelled the brackish waters and completely obstructed the waterway. All this seems to have happened before the Christian Era.

This area is presently occupied by Rossio, Figueira, and Martim-Monis squares. It continues between Ouro and Fanqueiros streets and ends in Terreiro do Paço Square.

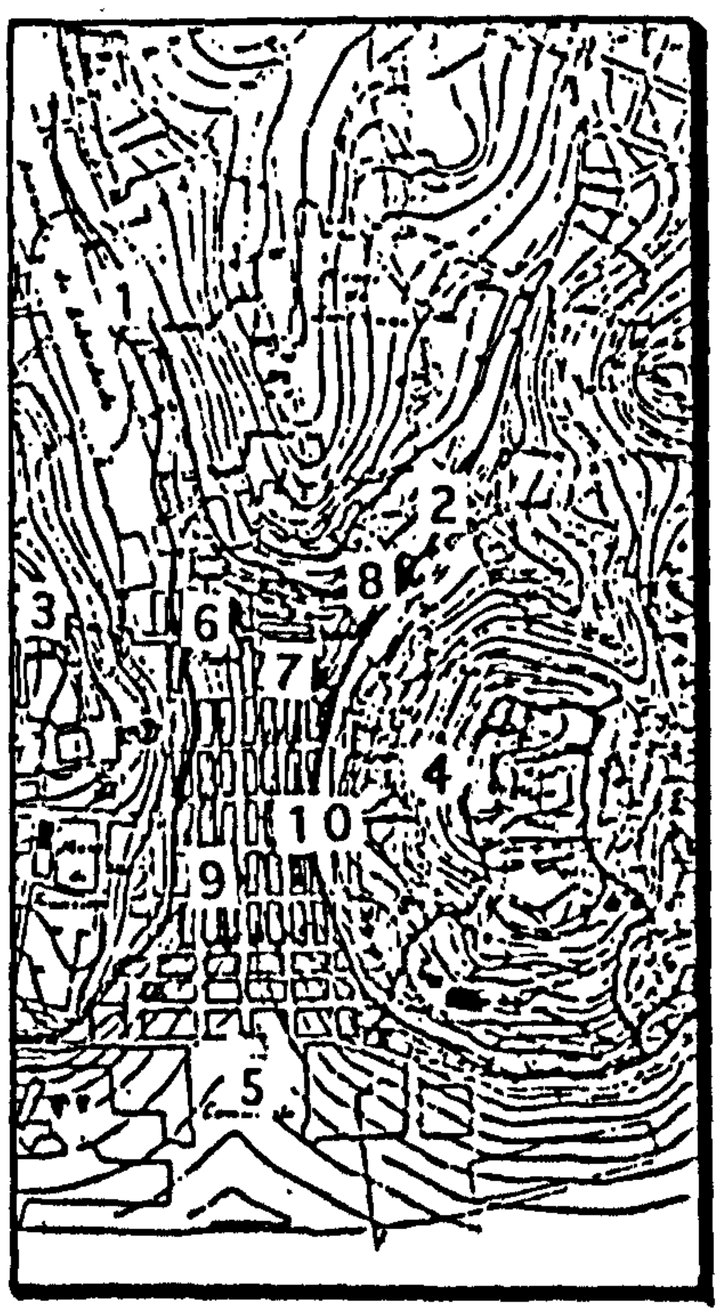


Fig.2-The creek.

Due to the reasons mentioned above, the area where the Alfama and the Castle sit was occupied by numerous peoples over a period of time, (Figure 4 shows the initial nucleus before the Roman occupation).

The Phoenicians, who were great navigators, were the first to settle due to "the beautiful and exceptional exposition of the hill standing by the calm river inlet", named thus "Allis Ubo". The corrupt version was "Olisipo" which was later to become "Lixbuna"(2, 5).

The Romans took the city after conquest of the Lusitanians by the Roman General Decimus Junius Brutus, between the years 100 B.C. and 45 B.C.. The Emperor Julius Caesar promoted the city to the category of Roman Municipality and at the same time named it Felicitas Julia. By the kind of vestiges found, it seems that it was an important city full of life and splendour, and remained so for nearly 400 years, (Figure 3 shows the oldest iconographic reference to the city)(2, 3).

During the fifth century the Barbarians, the Alani, Vandals, and Visigoths, succeeded the Romans without leaving any significant vestiges(3).

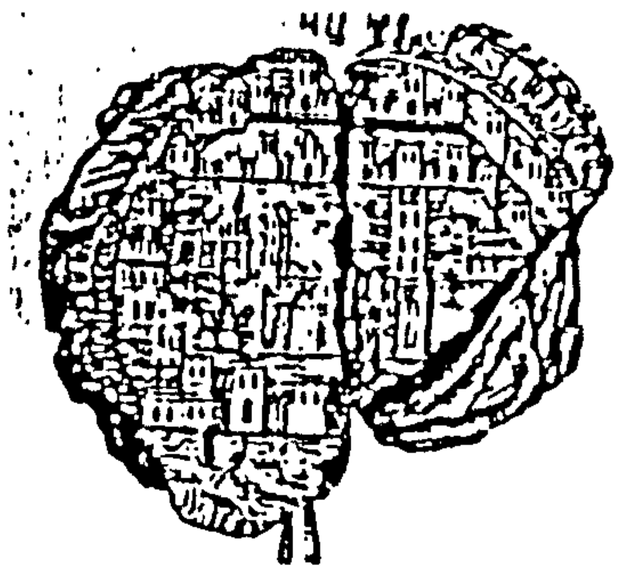


Fig.3-An old iconographic reference.

Fig.4-Initial nucleus, before the 2nd century B.C., Roman and Visigothic occupation.

Portugal and Spain together, form the Iberian Peninsula.
Thousands of years before these two Countries became Nations, other people lived in the Peninsula.

The Ligurians were the first, followed by the Iberians, the Phoenicians, the Greeks and the Celts, mingling from which later the Lusitanians resulted.

The Lusitanians were subdued by the Roman invasion of the Peninsula.
The Romans remained for hundreds of years leaving behind numerous evidence of their occupation.

After the fall of the Roman Empire.
Many different peoples invaded the land.
The Teutonic tribes subdued and converted all the other peoples to Christianity.

An army of Berbers, invaded the Iberia Peninsula defeating the Teutons and pushing them up North.

-Brief summary of the history of Portugal.

The Moslems occupied the city in 714 A.D.. They built walled compartments on the Castle hill transforming it into a prime war fortress. Then in the beginning of the IX century, it was taken by Afonso, "The Caste" king of Galicia and Asturias (3).

The city was re-taken by the Arabs in 831 A.D. and subsequently in 851 A.D., it was taken and plundered by Afonso IV, king of Leon. Later it was again reoccupied by the Arabs. It was then taken by Afonso VI King of Leon and Castilla in 1093 A.D. and a few years after, it was once again retaken by the Moslems(3).

On October 24th, 1147 A.D., Lisbon was finally taken into the Christian faith by D. Afonso Henriques, first king of Portugal, after a three months´ siege (see Fig.5). He was helped by the Crusades of English, German and French origins. Immediately after the conquest of the City, it was necessary to settle it in order to ensure its occupation by people of the Christian faith, (Fig.6)(6).

Fig.5-The conquest of Lisbon by D. Afonso Henriques.

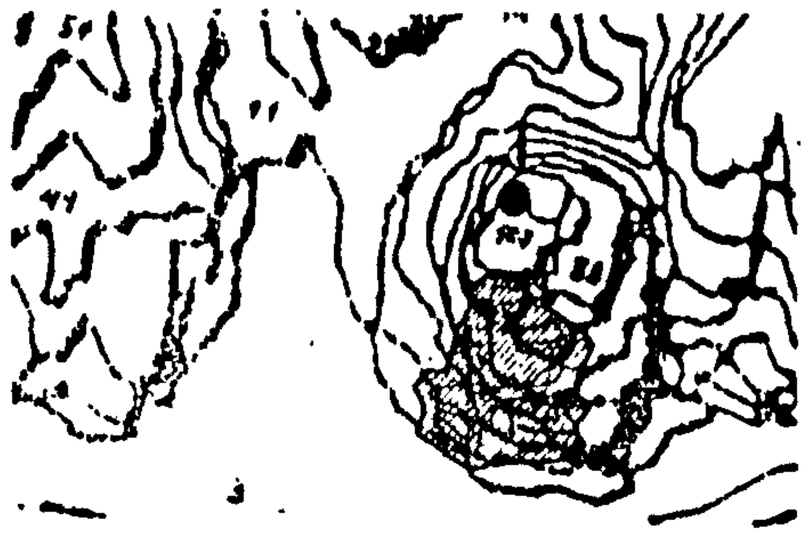
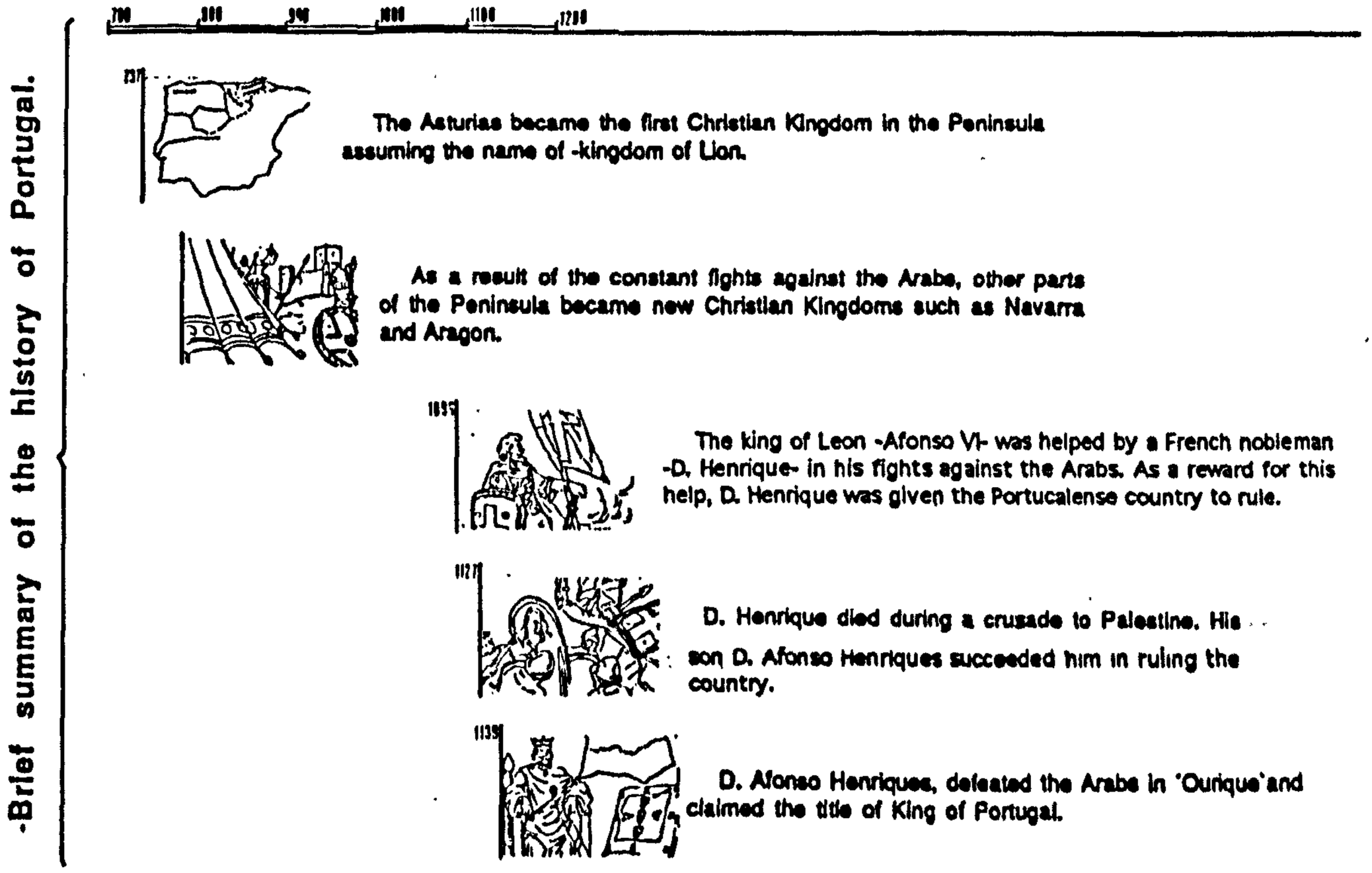


Fig.6-The Moorish walls and the urban growth.



Measures of a religious character were taken by setting up Military Orders, in which monks also operated as soldiers. This led to widespread building of monasteries which attracted surrounding development and promoted demographic growth(3).

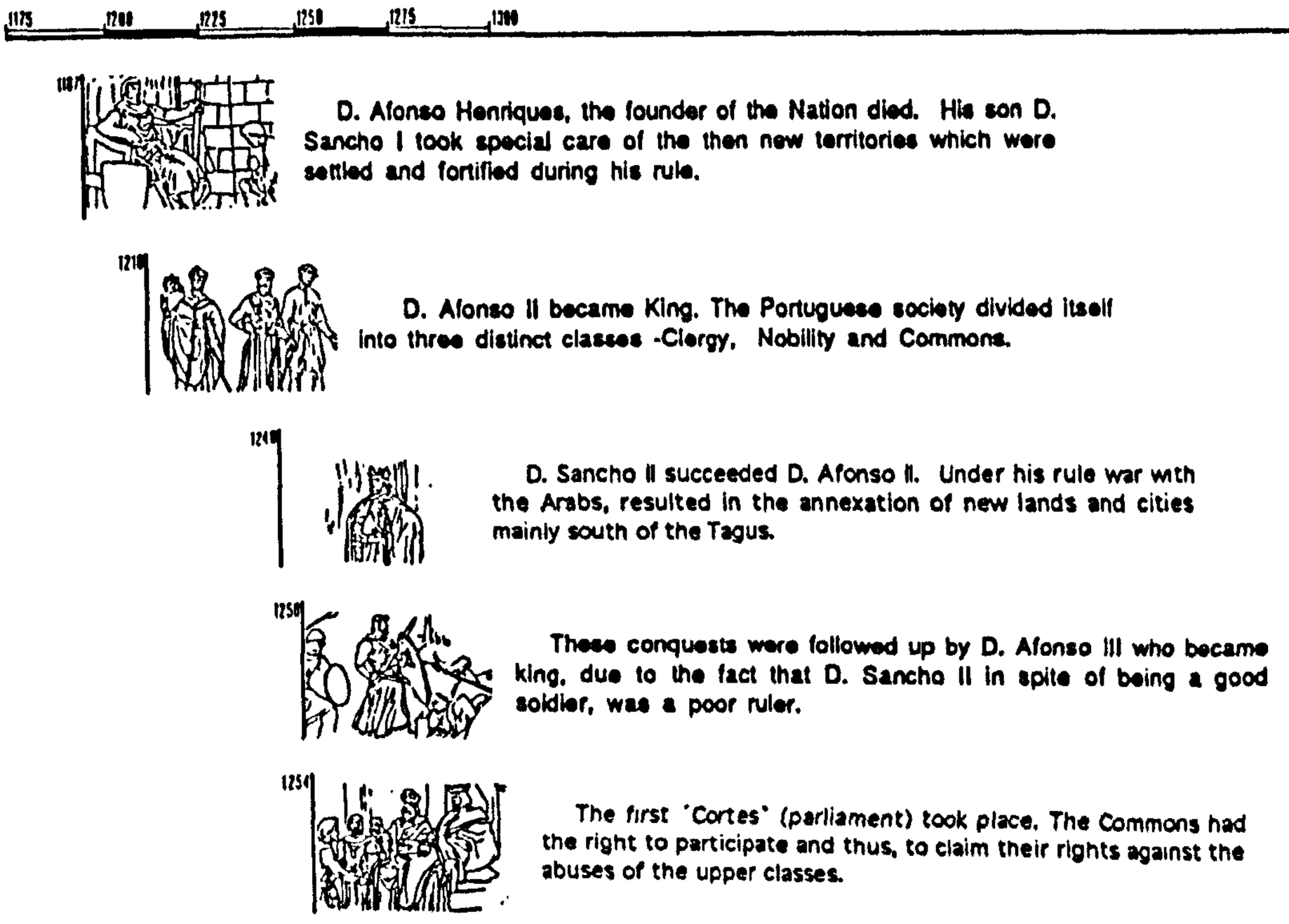
However the real urban growth and development took place during D. Afonso III´s rule. He was the first king to establish residence in Lisbon, in 1255 A.D. and Lisbon became the new capital (see Figure 7), a fact that helped to increase the trading with Mediterranean ports. During this period the city´s defensive belts became obsolete since the Arab military activities slowed down. In this way, construction started taking place beyond these belts (see Figure 8)(3).

The nature of building form and construction was determined by the abundance of local calcareous materials and clay and the lack of forests in the Lisbon area. This, along with the surviving Arab building tradition of single storey dwellings may have restricted the development of multi-storey buildings(3).

Fig.7-View of Lisbon, between 1175-1275.

Fig.8-The urban growth upon the obstructed alluvium.

-Brief summary of the history of Portugal.



The reign of D. Dinis (1279), brought wide economic reform which resulted in an increase in land values. A certain street parallel to the river (Nova dos Ferros Street) took on a special role. Here merchants would carry out important commercial and financial business(7).

The growth of the city was always parallel with the river and therefore occupied a narrow band.

In 1356, the city suffered a very severe earthquake which caused considerable damage. Several years later the city suffered further damage due to a different cause. Due to the war between Portugal and Castille, in 1373, Lisbon was placed under siege by an enormous Castillean army, (see Fig.9), during which the city was victim to many horrors as the suburbs were set on fire. Lisbon thus became restricted to a cluster of houses within the city walls which were built by order of D. Fernando I, (see Fig.10)(7, 8).

Fig.9-Lisbon besieged by the Castillean Army.

Fig.10-D. Fernando walls

In 1384, D. Juan I of Castille besieged the city by land and sea. After five months of fighting characterized by extreme violence, the enemy withdrew leaving behind many ruined buildings and warships. After the death of D. Fernando I, in 1385, many rebellions took place, both in Lisbon and in the interior of the Country, when the people wanted D. João I for King. During this period, the streets were sombre, badly paved, irregular in layout and frequently the tenants´ nick names were used as toponymic locations. Most of the houses were small in area and façades were out of line. The drainage systems were very poor and conditions were very unhealthy and unhygienic. (Figure 1·1 shows a general view of Lisbon in XIV century)[7, 8, 9].

During the reign of D. João I, came the beginning of long sea voyages and the great conquest of Ceuta by D. João I, and so the XV century proved to be a period of great prosperity for Lisbon, (Figure 12 shows Lisbon in XV century). Also the Monarchy took a certain number of measures, in order to prepare Lisbon for its future role as a dynamic operations centre[8, 9].

Fig.11-A general view of Lisbon (XIV century).

Fig.12-Lisbon in XV century.

-Brief summary of the history of Portugal.

1375 1400 1425 1450 1475

The King Juan of Castille, invaded Portugal and forced the Portuguese king to give him his daughter Beatriz for wife. This event endangered the Portuguese independence.

1384

The Castillians although superior in number were defeated in the Atoleiros battle, by the Portuguese troops led by D. Nuno Alvares Pereira.

1385

D. João I was proclaimed king of Portugal.
As a result of an alliance between the Portuguese king and the Duke of Lencaster, which established a bilateral pact of help, The Treaty of Windsor was established. D. João I took D. Filipa de Lencastre for wife.

1415

D. João I conquered Ceuta.
His son D. Henriques, founded the "Escola de Sagres" where he trained the navigators who later would achieve so much glory with their discoveries.

1433

D. Duarte became king but died five years later victim of the plague. After becoming king, D. Afonso V conquered Arzila, Tangiers and Alcacer-Kabir.

The golden era of discovery really began during the reign of King D. Manuel I (1495), and after the arrival of Vasco da Gama in India. The king left the medieval Castle on the hill and installed his court near the river, (see Figure 14). The city port was modernized in order to accommodate the Royal Palace plus several customs services, thus concentrating the urban centre in that area, but resulting in there not being any available spaces to build in the areas immediately adjacent to this urban centre [8].

In spite of its wealth, with its new important buildings and connections, Lisbon was a dirty city, crowded with pedlars and possessing a defective water supply. There was no clear urban strategy. The streets were terrible; they were narrow, irregular and interrupted with steps [10].

During the reign of King D. João III (1521), Portugal had begun to amass a vast empire and the bourgeoisie, wealthy due to the commercial development, started to build extensively, (Fig. 13) [8, 9].

Fig.13-A general view of Lisbon (XVIII century).

Fig.14-D. Manuel installed the Court near the river.

The city began enlarging rapidly and the fields that surrounded it soon became new districts. However the city still maintained its previous image, acquired in its Moorish past, together with the influence from its close relations with the Flemish and with other Northern European ports(11).

The second quarter of the XVI century brought several disappointments. The spice trade from India declined. The Tribunal of the Inquisition was established, resulting in repugnant events like the persecution of the Jews. The great plague brought suffering and death. The earthquake of January 9th, 1531 caused deplorable loss of life and property(11).

On the western extremity of the plan below (Figure 15), there is a network of streets which intersect orthogonally, the lay-out of which is easily distinguished from the rest of the area. This is the Bairro Alto and its occupation was determined by a complex system of letting, (see Figure 16). This orthogonal layout might have had some influence on the design of the Pombaline area after the earthquake in 1755.

Fig.15-A general view of Lisbon (XVI century)

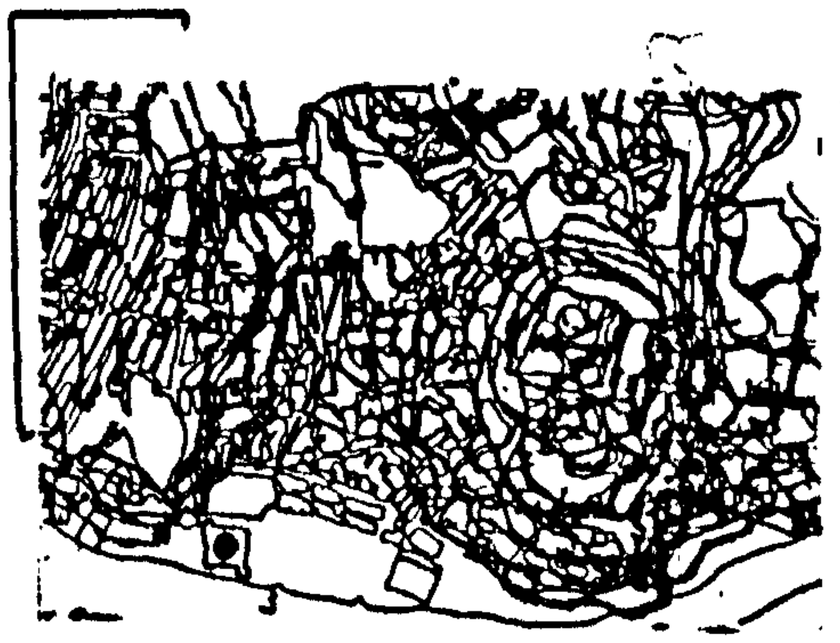
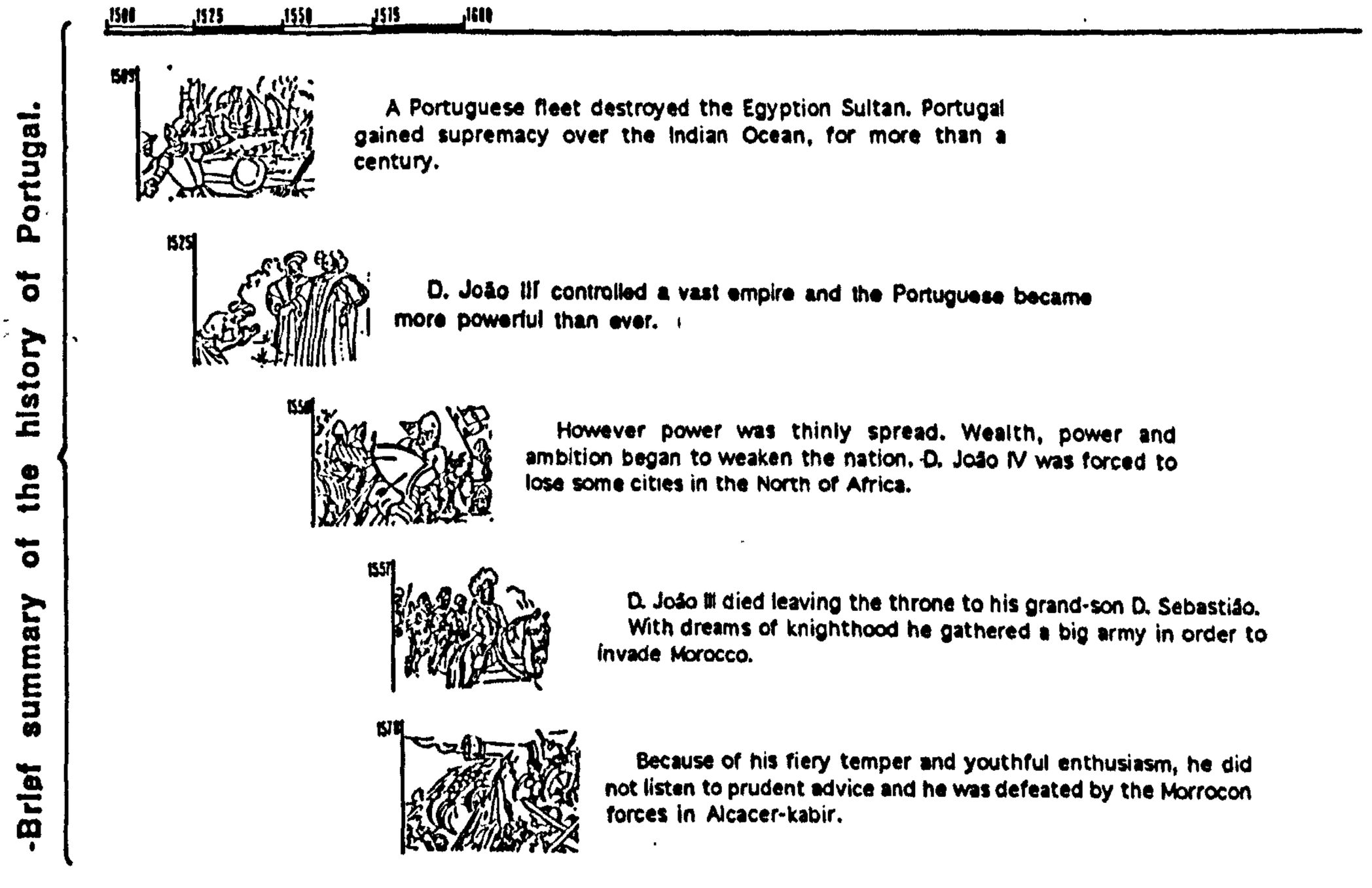


Fig.16-Plan of Lisbon (XVI century), on the left extremity is the Bairro Alto.



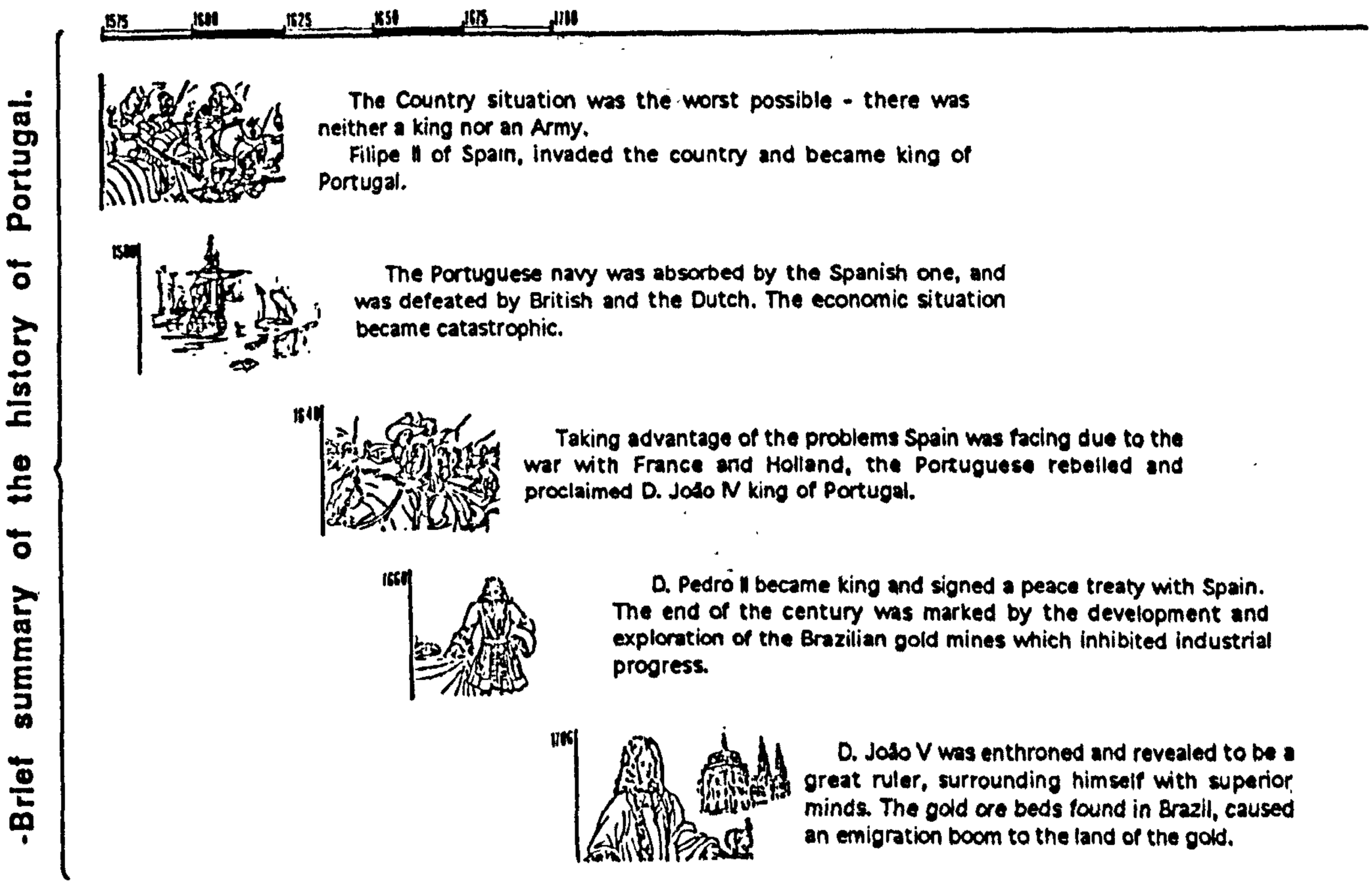
A further earthquake occurred on the 28th of January 1551, and in 1569 the plague struck again(10).

The loss of D. Sebastião in 1578 in war with Morocco, instigated a consequent crisis, which enabled "D. Filipe II" of Spain to invade the country and transform Portugal into a simple Spanish province (1580). It was a period of pain and ruin for Lisbon. (Figure 17 shows a general view of Lisbon in 1593)(12).

In 1640 Portuguese independence was restored, and the situation changed rapidly. D. João IV, making use of an able political acumen, achieved the reorganization of the economy, in a nation eager to overcome the crisis. The city acquired a new look with the construction of many new buildings. With the Brazilian settlement in the late part of XVII century, there was an expansion of religious buildings typical of that period(see plan on Figure 18), but the streets were unsafe (obstructed by buildings) and unhygienic (13).

Fig.17-A general view of Lisbon, (1593)

Fig.18-João Nunes Tinoco´s plan 1650



By the beginning of the XVIII century, the lower part of the city was a maze of streets and alleys which intersected between the two main squares, the Rossio and Terreiro do Paço. It was then a Medieval city, densely populated and constantly vibrant with economic activity, (Fig.19). However all was not well as the country had been using its gold reserves for imports and the country was sliding into economic decline(13).

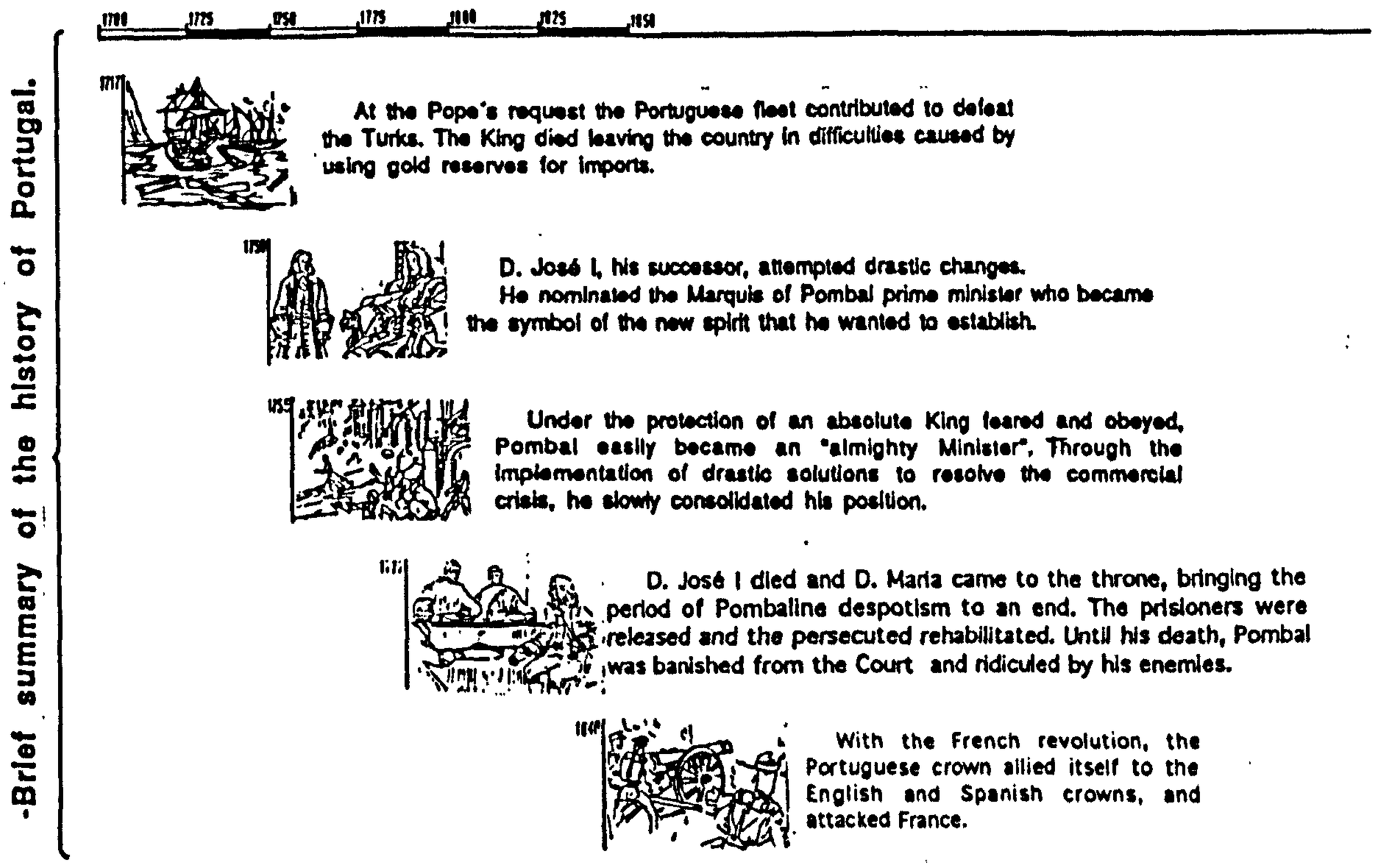
Then a terrible disaster struck. In 1755 the lower part of the city was wholly destroyed by earthquake and subsequent fire and had to be rebuilt. The King, D. José I gave to the Prime Minister, Marquis de Pombal, extensive powers to rebuild the city(14) (Fig.20, plan of the rebuilt city).

However, twenty-two years after the earthquake D. José I died and with his death the period of Pombal domination came to an end and all public building work, which had already been progressing very slowly for some time, was temporarily suspended(2).

The Court moved to Queluz, as if rejecting Pombal´s Lisbon. Although the city was enjoying a certain prosperity Lisbon had little magnificence or majesty(15).

Fig.19-A general view of Lisbon (XVIII century)

Fig.20-The lower part of the city was completely razed to the ground and the Pombaline centre built in its place.



The rebuilding of the lower part of the city, initiated by the Marquis of Pombal in 1756, was carried out over a period of 74 years(15). Within this period (1806-1812) there occurred the French invasions which were notable for the depredations carried out by the French army. In 1822 Brazil became independent creating a certain economic instability.

Later, during the period of the Liberal Struggles (1826-30), only a small section of the nobility and the bourgeoisie continued their economic activity. There was a small boom in the construction of strictly utilitarian buildings, but for economic reasons; there was no artistic or architectural development whatsoever(4).

After 1830 the population of Lisbon stabilised at around 200 000 inhabitants, (a general view and plan of the city in 1844, is given in Fig.21). Due to a series of crises and consequently an appalling economic situation all building construction was practically paralysed until 1855. Gradually the reconstruction plans came to be ignored(16).

Fig.21-Plan and general view of Lisbon in 1844.

-Brief summary of the history of Portugal

1800 1825 1850 1875 1900

The French army with 30.000 men invaded Portuguese territory, because they had insisted on keeping their ports open to British ships.
The royal family took refuge in Brazil.

French soldiers commited several crimes against the Portuguese people. The French were driven out with the help of British troops.
The French army reorganised and made two attempts to invade the capital, being defeated upon the arrival of the British General Beresford, in 1817.

A climate of instability was created due to the excessive spending of the Exchequer, the court remaining in Brazil and the British army's insistence on staying on in Portugal.
A revolt took place and D. João VI was proclaimed King. Later on, his oldest son, D. Pedro I proclaimed independence for Brazil with himself as Emperor.

Later the second son, D. Miguel was proclaimed King of Portugal and opposed the Liberals.
D. Pedro I disagreed with this and with a force of 1500 men he took Lisbon and obliged D. Miguel to go into exile.
Then the courts were convened.

I.3.The 1755 earthquake and its effects.

I.3.1.The precursors.

Lisbon, in the XVI century had been a real cosmopolitan city and the commercial trading centre of South Western Europe. It started to decline towards the end of the XVII century, (see a general view of Lisbon on Fig. 22a)(2).

The violent earthquake (of 1755) completely changed its urban and architectural features. It caused the destruction of its cultural and economic roots and changed a Moslem city into a new modern Renaissance city.

Since Roman times and more frequently after the XI century, Lisbon had always been subject to seismic movements, in particular the earthquake of 1531, but the worst shock was to come two centuries later, in 1755 (*), (Fig. 22b).

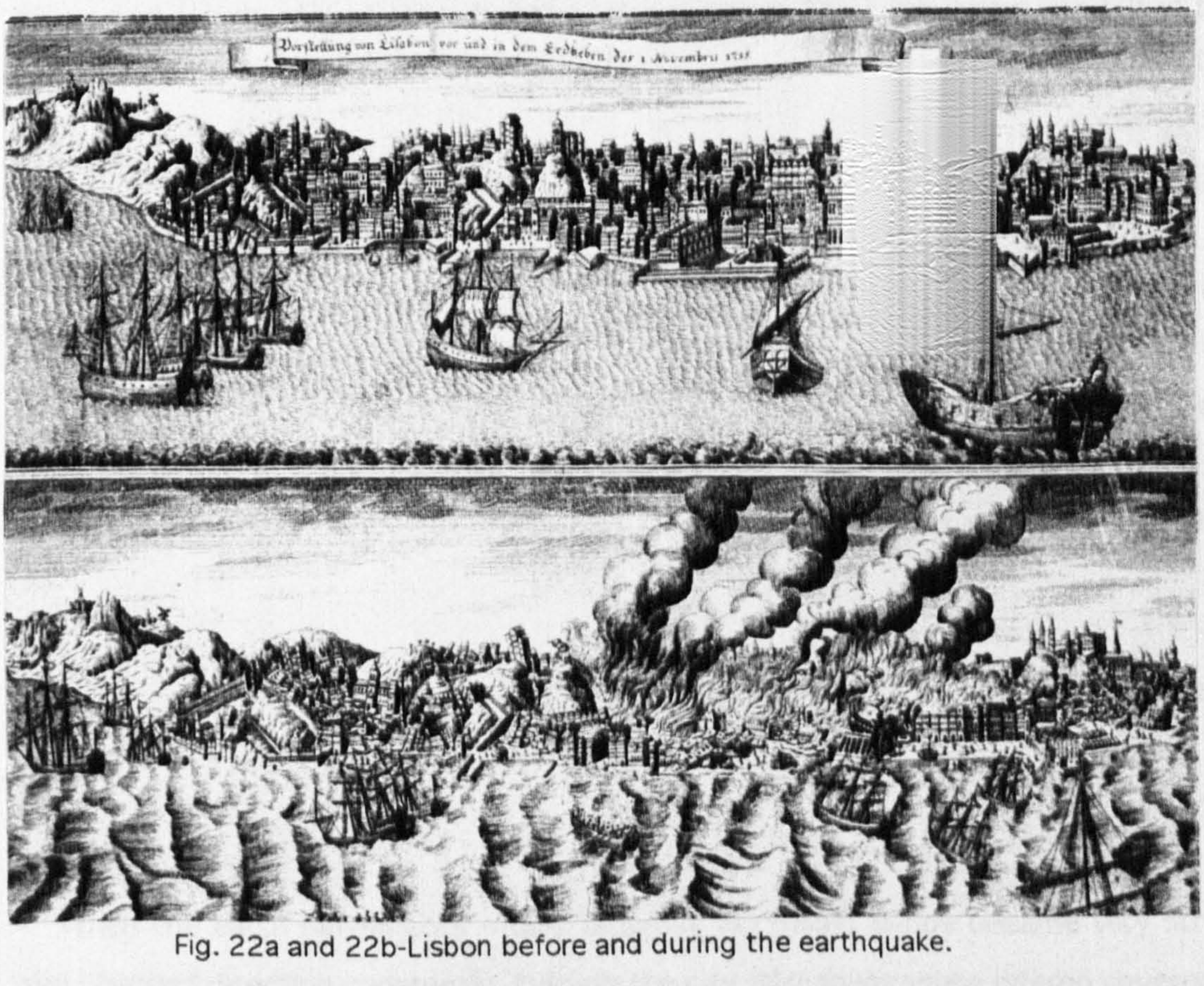


Fig. 22a and 22b-Lisbon before and during the earthquake.

(*) in Expresso, 6th May 1989, Lisbon.
60B.C.-Accompanied by a tidal wave, destroyed entire townships on coast of Portugal and Gallicia.
47-44B.C.-Tidal wave followed by earth tremors.
33A.D.-Strong earthquakes occurred causing great damage
382A.D.-Caused great damage, submerging islands situated in front of the Cape of St. Vicente.
22.2.1279-Strong tremor felt throughout country.
9.12.1321-Three violent earthquakes
1344- Accompanied by long subterranean sounds caused considerable damage in Lisbon area.
1355-Two major earth quakes registered: 11th Julyand 4th August.
24.7.1356-quakes hit Lisbon of similar intensity to that which was to occur in 1755.
1504-Strong earthquakes throughout this year which destroyed whole townships
1512-Lisbon felt terrible earthquake which took around 2.000 lives.
26.1.1531-One of the biggest earthquakes occurred affecting the Portuguese continent, the epicentre of which was the Lisbon region. Some Houses were levelled and seven people died.
27.12.1722-Very strong earthquake in south of the country.

I.3.2. Description of the catastrophe.

Prior to All Saints day the population of Lisbon noticed that the river waters had risen and new springs had appeared. On All Saints day, the first day of November of 1755, all the churches were full of people attending services. At exactly 9:40 a.m. of that Saturday morning, a weak northeast wind blew over the city. The sun was shining and had started to warm up the morning of that Autumn day, when the first shock wave was felt. During the following 17 minutes the earth shook violently with South-North movement, together with a frightening noise. The main earth movement lasted for two minutes and the walls of many buildings were destroyed, being unâble to resist the movements(6, 17).

The earthquake reached 10 on Mercali´s scale, and was accompanied by terrible noises and clouds of dust that darkened the sunlight. The earthquake was felt in the South of France, Belgium, in Hamburg and more strongly in the North of Spain. The orientation Southwest-Northeast that it took in Lisbon was due to the fact that the city sat on an enormous alluvium which is precisely orientated, and unstable in the region of the river (6, 17).

The instability of the great alluvium allowed the city, under the influence of the earthquake, to vibrate and shake with the major movement in the direction of the river. The collapse of buildings and the chaos that ensued resulted in the widespread outbreak of fires, (Fig. 23- shows the extent of the earthquake and the fires) (6, 17).

More than anything, it was these fires that during the ensuing five or six days destroyed most of the buildings which had resisted the earthquake. For instance, Rua dos Ourives in the central part of downtown was completely destroyed by fire, which made any attempt at reconstruction impossible. In certain cases the fires were started by bandits and army deserters (6, 17).

There were also a number of secondary shocks which made the situation even more devastating (6, 17).

When the earth movements finally stopped, northeast winds became very strong and changed direction constantly, turning the city into an immense inferno covered by a thick cloud of smoke. This made criminal acts such as robbery, rape and murder easy (6, 17).

During the following ten days, four abnormally high tides were registered (6, 17).

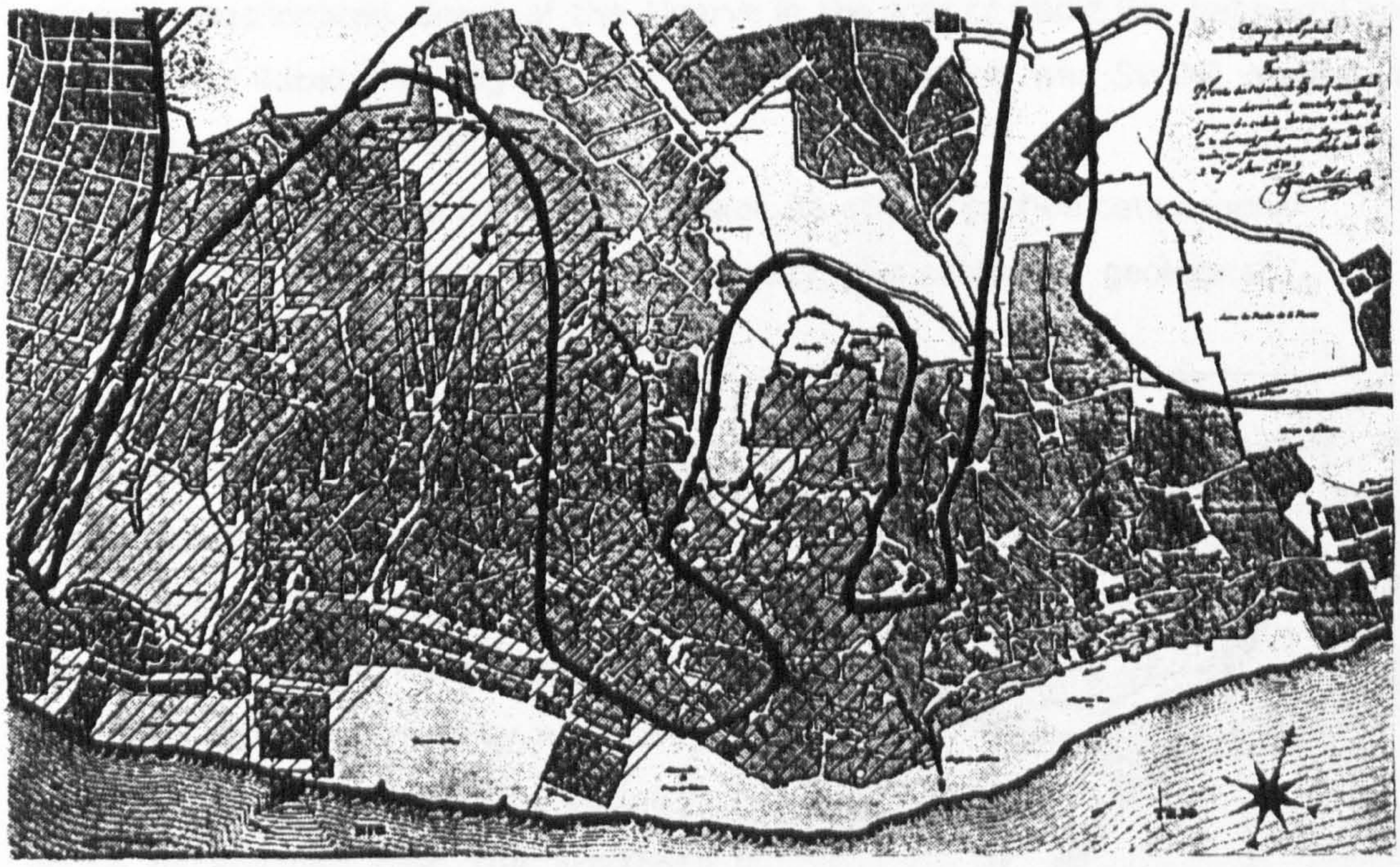


Fig.23-Limits of the earthquake (////) and the fires (—).

It has been estimated that ten to fifteen thousand people died in the earthquake, and 2/3 of all houses were no longer fit for habitation, (Fig. 24 illustrates its effect on some buildings[2].

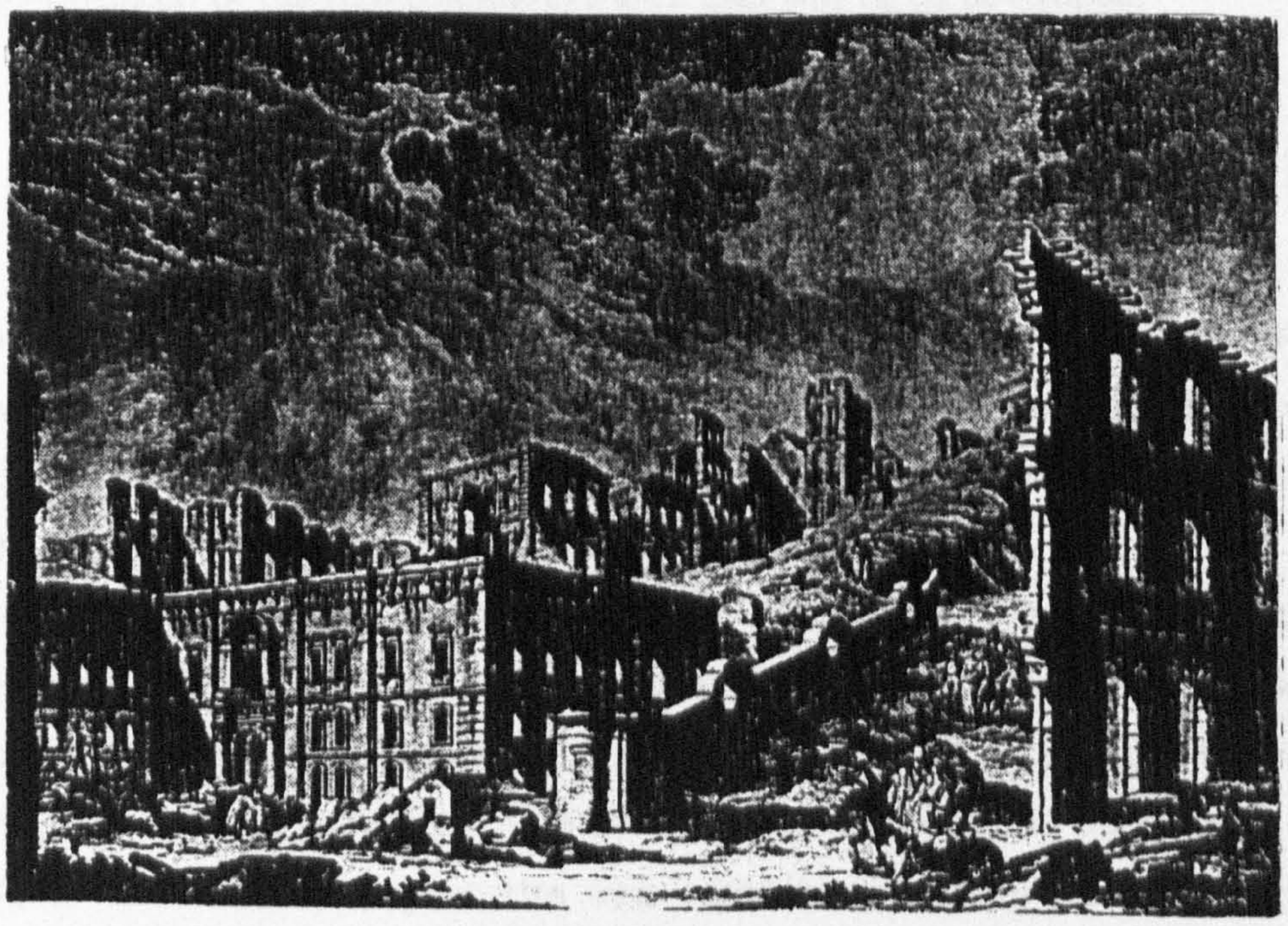


Fig.24-Patriarchal ruins.

Although the earthquake is always associated with the destruction of Lisbon, its epicentre was located South of the Algarve in the area of Cadiz Bay between Cape S. Vicente and Rabat (see Fig.25) [2, 5, 17]. It`s direction was SW-NE making wall vibrations stronger in that direction.

In Lisbon although the tremor was weaker, its effect reached catastrophic proportions due to the high population density, the particular geological location and the fires which lasted for five to six days.

The sea action was in part dissipated due to the fact that the city was located on an estuary defended by reefs which caused transverse wave movements. This fact was confirmed by an inquiry made of all priests all over the country, which established that the Southern coastal regions were where the earthquake was felt most strongly (15, 17).

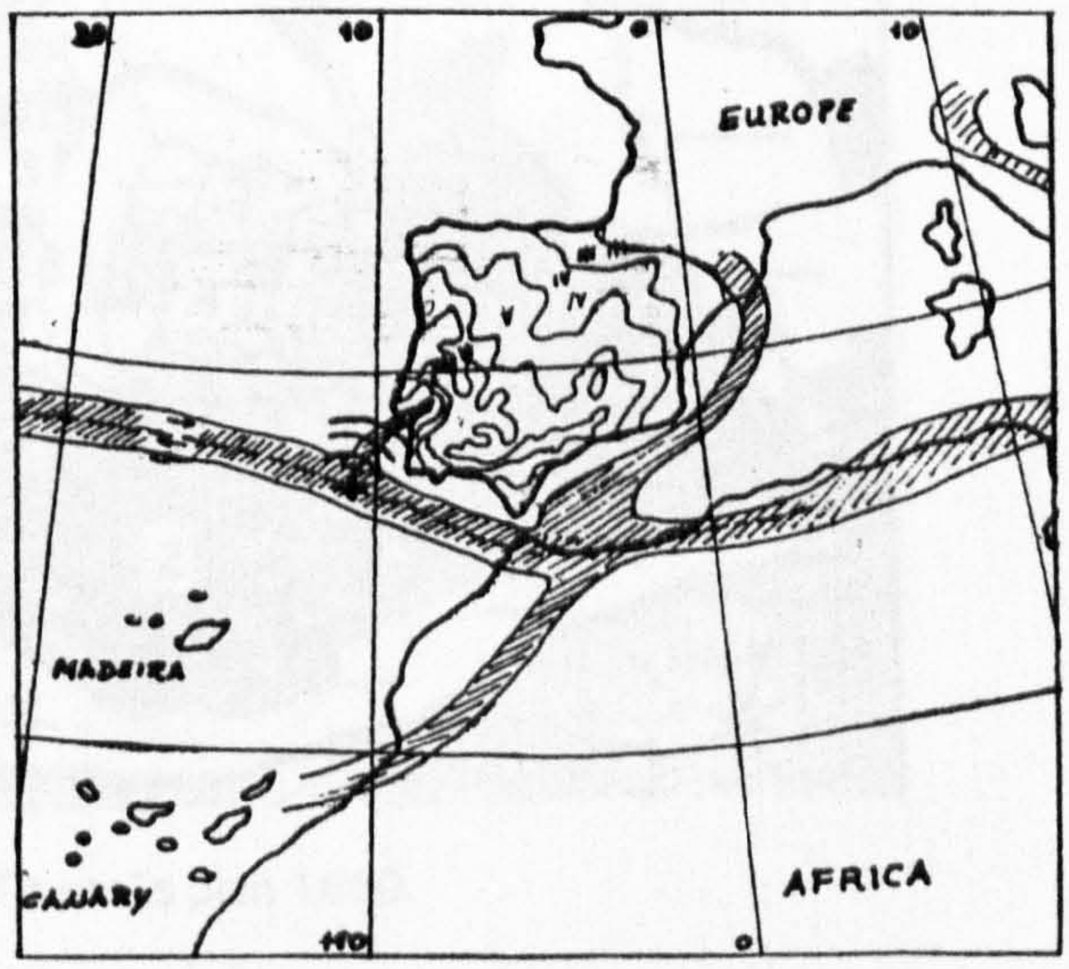


Fig. 25-Intensity of the 1755 earthquake over the Iberian Peninsula.

I.4. Identification of the new commercial area that was to be developed.

I.4.1. The city plan before the earthquake.

The part of the city flattened by the earthquake was a picturesque and commercial area which had been a great trading centre and world market during the XVI century. It had, however, grown in a chaotic fashion to suit the commercial aspirations of the merchants [2].

The lower part of the city built prior to XVIII century and destroyed by the earthquake was a real maze. It is illustrated by the plan produced by João Nunes Tinoco which is shown in Figure 26, (on next page). It included eight Kilometres of streets, courts and alley-ways. There were 70 dead end streets, 50 open streets and 16 squares. It was here that the new commercial centre was to be built and re-established under the direction of the Marquis de Pombal[2, 17].

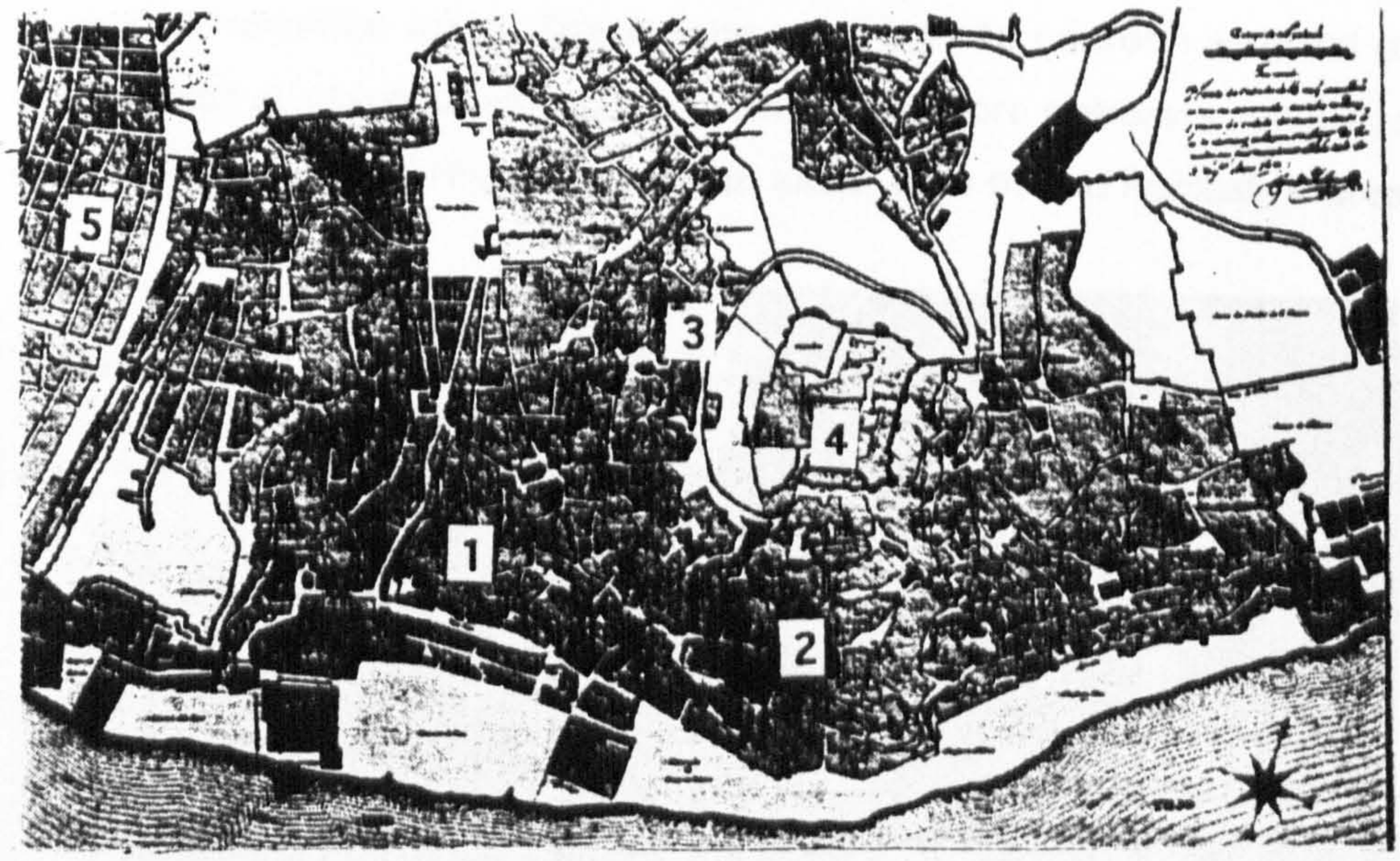


Fig. 26-João Nunes Tinoco´s plan 1650.

The areas indicated in João Nunes Tinoco´s plan (Fig. 26) are:

1 The lower part of the city.

2 Alfama, on the southern slopes.

3 Mouraria, on the northern slopes of the Castle hill.

4 Castle hill, an area densely built up with narrow tortuous streets.

5 Bairro Alto which is a typical example of Middle Age planning, (see section I.1)

The lower part near the river was more humid and was occupied by ordinary people living in flats whereas higher up the aristocracy settled in small palaces.

I.4.2. The Pombaline reconstruction area.

For the purpose of this study, the Pombaline area is considered as a rectangular area (see Glossary), of 0,24 Km^2, (300 by 800m), sitting between the Castle Hill and that of S. Francisco which bound it at the east and the west respectively. It is limited at the north by Rossio Square and at the south by the River Tagus. To this rectangular area is linked a narrow strip which runs towards Cais do Sodré, (Fig.27 shows the proposed plan of the reconstruction commissioned by Eugénio dos Santos).

This area is characterized by the uniformity and regularity of the buildings in extreme conformity with the requirements of the reconstruction plan. It includes 53 blocks, 400 rentable buildings, of which 315 are Pombaline and approximately 1344 flats, ((170x2+108)x3, 170 buildings with two flats per floor and 108 buildings with one flat per floor and each building with 3 floors). There are also areas which may be termed transition areas. These areas were built to conform with the plan but were constructed at a later stage, so the buildings are more elaborate and less austere than the original buildings, (Fig.28 shows an aerial view of the Pombaline area)[18].

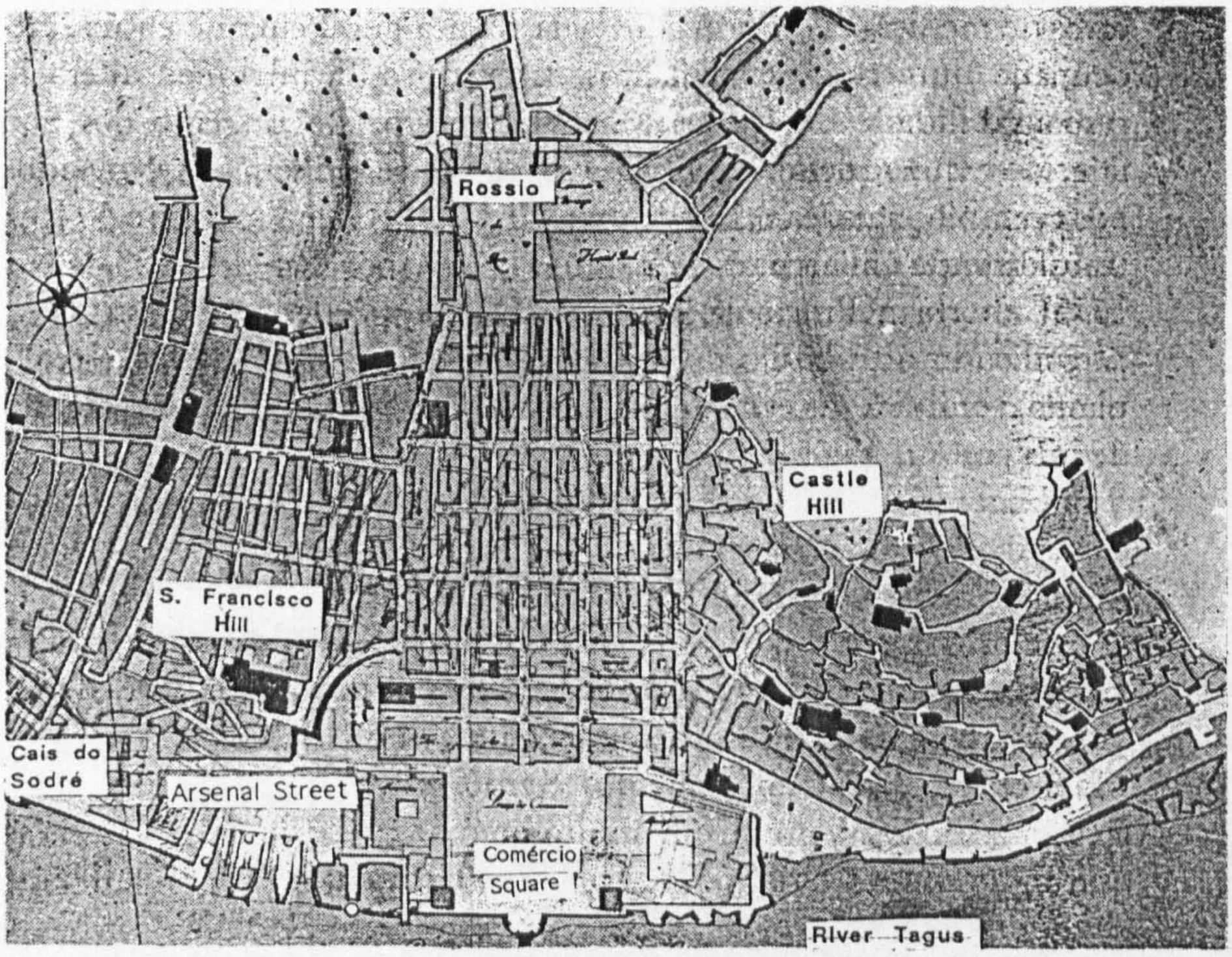


Fig. 27-After the earthquake (1755)

The proposed plan of the reconstruction.

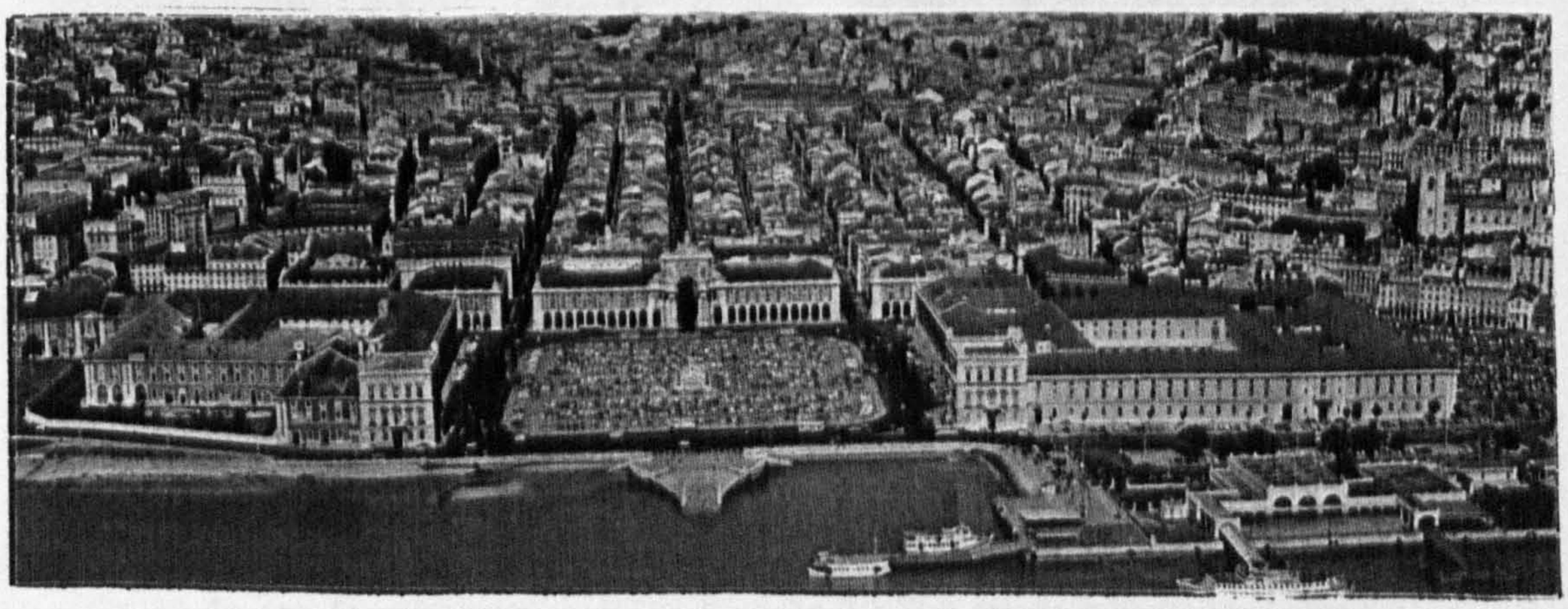


Fig.28-Aerial view of the town area rebuilt by the Marquis of Pombal

I.5. The background to the reconstruction of the new city

I.5.1. The Marquis de Pombal´s role in the reconstruction.

The Marquis de Pombal, who was the Prime Minister of King D. José I, handled the crisis caused by the devastation competently and kept in good spirits. His energies were directly channelled into overcoming the devastation created by the disaster (19).

He immediately mobilised all the available troops to clear paths through the debris and to search for survivors, (see Fig.29). In order to avoid the danger of plague, the dead were promptly buried (20). Provisional hospitals were created to care for the sick and camp sites were set up to give shelter to the injured and the homeless (21).

A survey was carried out to gather information about what had been destroyed. All kinds of construction outside the city limits were forbidden. The destruction of any unauthorised construction was decreed and also no construction was to take place until there was a new plan for the city (17).

All available foodstuffs were collected and fairly distributed and it was decreed that food prices be fixed to prevent speculation (17).

Nothing at all was overlooked. It was as if the Prime Minister of King D. José I had already foreseen the catastrophe and had beforehand planned the way to overcome it, (Fig.30).

As early as the day following the earthquake he took measures to study the reconstruction of the new city. Thus the Marquis de Pombal´s power was reinforced. His actions were summed up when he said it was necessary "to bury the dead and look after the living" (1).

Fig.29-Search for survivors.

Fig.30-The Marquis of Pombal and his collaborators study the reconstruction.

In order to explain how Pombal was able to begin the regeneration of the city so soon after the earthquake it is necessary to understand his political ambitions and his position during the period prior to and immediately after the earthquake .

The reconstruction of Lisbon provided Pombal with the opportunity to regenerate not just Lisbon but Portugal, as he had felt that the former economic and maritime power had waned (2).

So to understand the process of renovation of the downtown city it is important to investigate the complex relationships between Pombal and Portuguese society. Pombal, (Sebasteão José de Carvalho e Melo - 1st Count of Oeiras) - the Minister of King D. José, was the most notable Portuguese statesman of his time being influential both in Europe and the New World (22).

In 1739 Pombal held the post of ambassador in London, where he negotiated on behalf of the Portuguese merchants in London to obtain privileges then enjoyed by the British merchants in Portugal. His stay in England was excellent preparation for his future government responsibilities (20).

On 21st July 1750, when King João V died, his son D. José I became king (Fig.31) and nominated the Marquis de Pombal as Counsellor of the Court Minister. Slowly but surely Pombal gained the reputation of being an excellent Minister, continually accumulating great prestige (2).

Pombal planned to put into practice a plan for significant reforms but there were serious difficulties due to the depletion of the state treasure as a result of extreme extravagance during the reign of the Magnanimous King, D. João V. He also knew, that to carry through his reforms, he would have to destroy the two classes that most benefited under D. João V, the Nobility and the Jesuits (2).

As he became more powerful he tried to displace them by giving the common people more privileges. By attempting this, he would reduce the power and wealth of the Nobility, creating many enemies.

Pombal governed in a despotic way. It was said that even the king feared him, but it was in this way that he was able to introduce his controversial reforms. In 1750 Pombal started to put his reforms into action. First he limited the flow of currency. He favoured industry by selectively abolishing taxes and reorganised the collection of taxes. He also established the efficient running of public services which had previously been chaotic (22).

He fought to free the country from foreign economic control. He set up the silk industry and prohibited exports of raw materials. Industry began to flourish (23).

This was followed by granting full commercial concessions to Portuguese merchants which permitted them to sail to Asian ports. Later he concentrated his efforts on creating Brazilian Companhias, (Grão-Pará, Maranhão and Paraíba), in order to manage the commercial wealth of these regions (21).

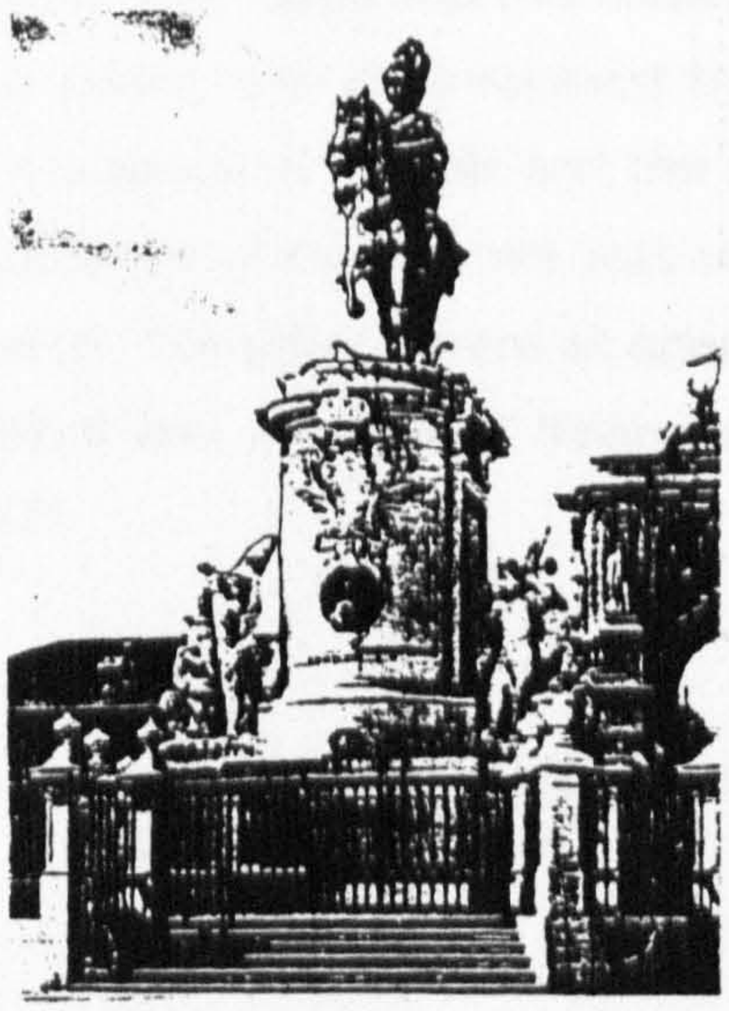


Fig.31-Equestrian statue of D. José I, at Comércio Square.

All these actions were greeted with very fierce opposition and created for him many more enemies. These in particular included the Jesuits and the Nobility, (24) who did not agree with the rise of the new commercial class. This was the type of environment which existed immediately prior to the earthquake.

In spite of possessing all the qualities of a Statesman, the Marquis of Pombal demonstrated a certain ruthless and cruel streak which in a way erased some of his good deeds. One such example, which occurred after the earthquake, was the repression in Oporto in 1757. This was when there was created the Companhia do Alto Douro, which caused a tremendous protest because it interfered with the free trade in wine. A serious revolt took place (25), and a detachment of troops was sent to the city. Thirty people were executed and many others were sentenced to lesser penalties and punishments.

As a result of this persecution and many other similar events, the Duke of Aveiro planned the assassination of the King D. José I. He thought that this would see the end of Pombal, but the plot failed and the Duke of Aveiro and his family were executed (26).

Pombal blamed the attempt on the king´s life on the Jesuits, whom he particularly hated and who had been closely connected with the Aveiro household. As a result Pombal asked the Pope to disband the Society of Jesus (6). Without awaiting a reply, he ordered immediate expulsion of all their members from Portugal in 1759. France and Spain followed his example and eventually the Pope gave way and terminated the Society of Jesus in 1773 (21, 27).

When the nobility and the clergy had been suppressed, the Marquis dedicated himself to the new reforms. Education was reformed, for example, at the University of Coimbra where the old traditional methods were replaced by new methods (28). In spite of achieving all these reforms, Pombal encountered many problems and suffered as a result of the existing inefficient government structures. His period of administration was therefore short.

On the 24th of February 1777, the king D. José I died and this ended Pombal´s reign of terror. His subsequent fall from power was accompanied by personal misfortune. He was ordered into exile at his palace in Pombal and the population was allowed to jeer and insult him. The jubilation of his enemies was undisguised and the people´s feelings rose to fever pitch. The prisons were all opened and all his political prisoners were released. Pombal was accused of having abused his power to gain personal power and wealth (2).

I.5.2. The relationship between the Marquis de Pombal and leading elements in society.

The Marquis de Pombal was in continual conflict with the Jesuits, whom he persecuted and against whom he encouraged anti-clerical theories (21).

However this should not be considered a religious quarrel. The relationships between the Prime Minister and the Catholic church and other religious orders, were cordial (21). He had close contact with the Franciscans amongst whom he found some of his best and most loyal collaborators. It was the Jesuits who caused the dissention between Pombal and the Pope. This quarrel created particular impressions of the Marquis de Pombal, which have filtered down to the present day. Although this problem was not exclusive to Portugal (France and Spain forced the Jesuits out of their territories about the same time), it underlines Pombal`s political determination and courage. The causes of the dispute were political and socio-economic not religious, and some were related to Brazil (29).

After the expulsion of the Jesuits from Portugal, by Royal Decree on September 3rd of 1759 (see Fig.32), Pope Clement XIV, himself an anti-Jesuit, disbanded the Companhia de Jesus thus restoring relations with the Portuguese crown.

Fig. 32-The Marquis de Pombal is informed that his orders have been carried out, as all the Jesuits have left.

The Marquis de Pombal was also in conflict with the nobility. A large part of the Portuguese Nobility were disturbed by the rise of the commercial and industrial bourgeoisie protected and encouraged by Pombal. This resulted in a kind of cold war attitude from the nobility since it could not fight Pombal openly (21). Several attempts to remove him from power took place. His fiercest critics even considered the King´s attempted assassination as a way to strike at Pombal. As previously mentioned an attempt on the life of D. José I was made on September the 3rd, 1758, when he was ambushed by the Dukes of Aveiro following a Jesuit plot (see Fig.33). The King and the Prime Minister decided to cover up the attempt while investigations were made. On January the 9th the accused were found guilty of the crime of lese-Majesty and on January the 12th, they were sentenced to death. The next day they were taken to a Square in Belém, and savagely executed (26). This is illustrated in Fig.34.

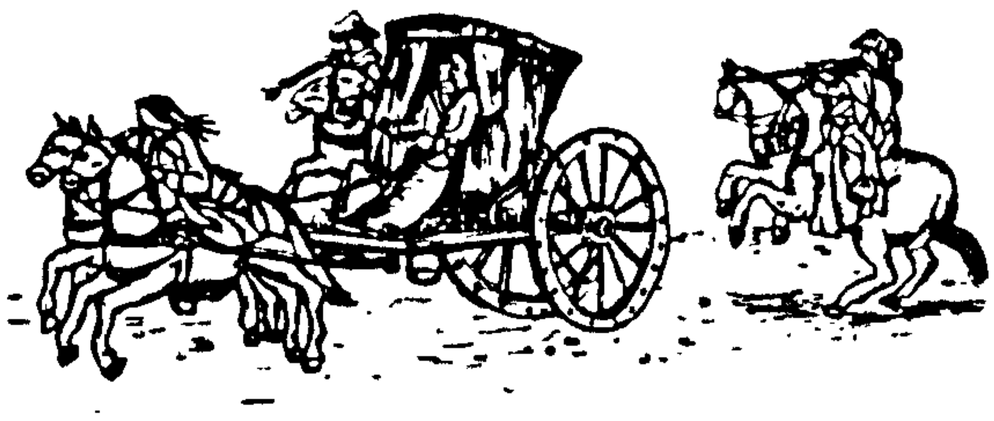


Fig.33-Assassination attempt of D. José I

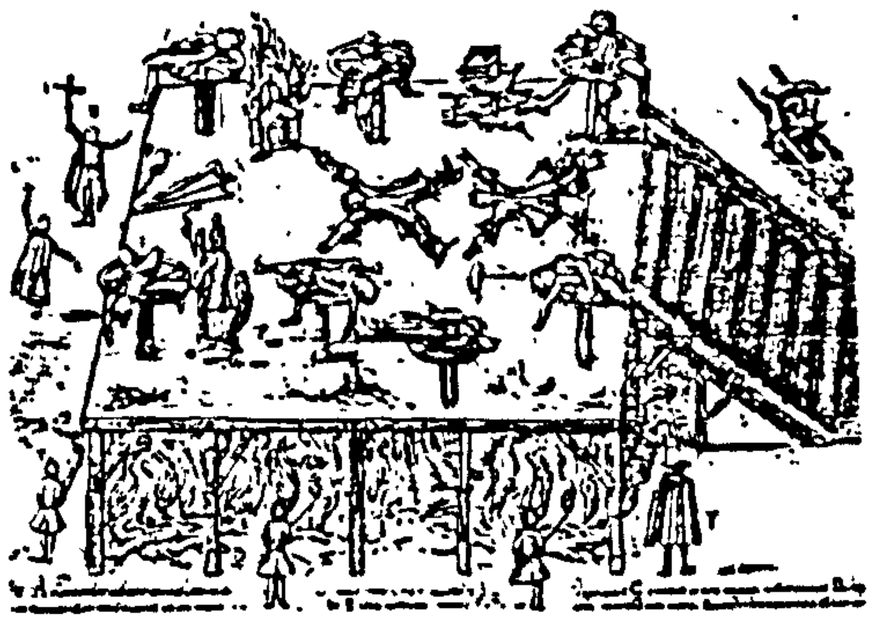


Fig.34-Execution of the Távoras

Pombal however found close allies in the Bourgeoisie, who were the new Nobility, enriched by overseas trading and made powerful by new important public posts. Prior to the earthquake all Portuguese trade both import and export was conducted through foreign trading houses. Even the retail trading was in the hands of foreigners. Only the trade with Brazil was still operated by Portuguese (21).

Foreign traders resident in Portugal represented many important foreign firms. All profits were channelled back home. This situation worsened during the rule of D.João V and Pombal´s interventions were intended to encourage Portuguese trade and industry (2).

After the earthquake some foreign firms went bankrupt, however others who chose to compete fairly saw their interests increase placing them on an equal basis with the national bourgeoisie, with whom they often intermarried. This group were able to gain high positions in the Public Administration, the Public Treasury, the Chamber of Commerce and the Customs Service in Lisbon. In this way a new nobility grew from this ambitious bourgeoisie.

The Prime Minister protected the new merchant class, so that Portuguese trade and industry could be encouraged and re-generated to compete with the foreign traders. Consequently tax and trading concessions were guaranteed [22]. This was the nature of the socio-economic climate which prevailed during and subsequent to the reconstruction of the city.

I.5.3. The reconstruction and the Chief Engineer Manuel da Maia.

To execute the reconstruction, Pombal relied on the expertise of certain technicians including Manuel da Maia, the Kingdom´s official engineer. He was an expert in fortifications and it was he who planned and executed the reconstruction of the new city. Figure 35 shows an eighteenth century portrait of Manuel da Maia.

Fig.35-Engineer Manuel da Maia.

The reconstruction of the city proved to be the peak of the notable career of this military engineer, who was then in his eighties. By looking at his rational proposals, we can see a "practical" man, a man of "good sense" and a professional who was always conscious of problems concerning safety and hygiene as much at the urban level as at the architectural level. He created the very specific "Pombaline style", characterized by its austerity and rationality [2, 30].

The proposals by Manuel da Maia for the reconstruction of the city comprised three major evolutionary stages. These are outlined in the flow chart presented in Figure 36. The first stage consisted of proposals for five possible basic approaches, which are discussed in the following sections.

I.6. Outline proposals for the first stage of the reconstruction.

The original texts of the proposals are presented in the Appendix I. They are in Archaic Portuguese and there are no illustrations. The following descriptions with illustrations of proposals and the licence are interpretations by the author.

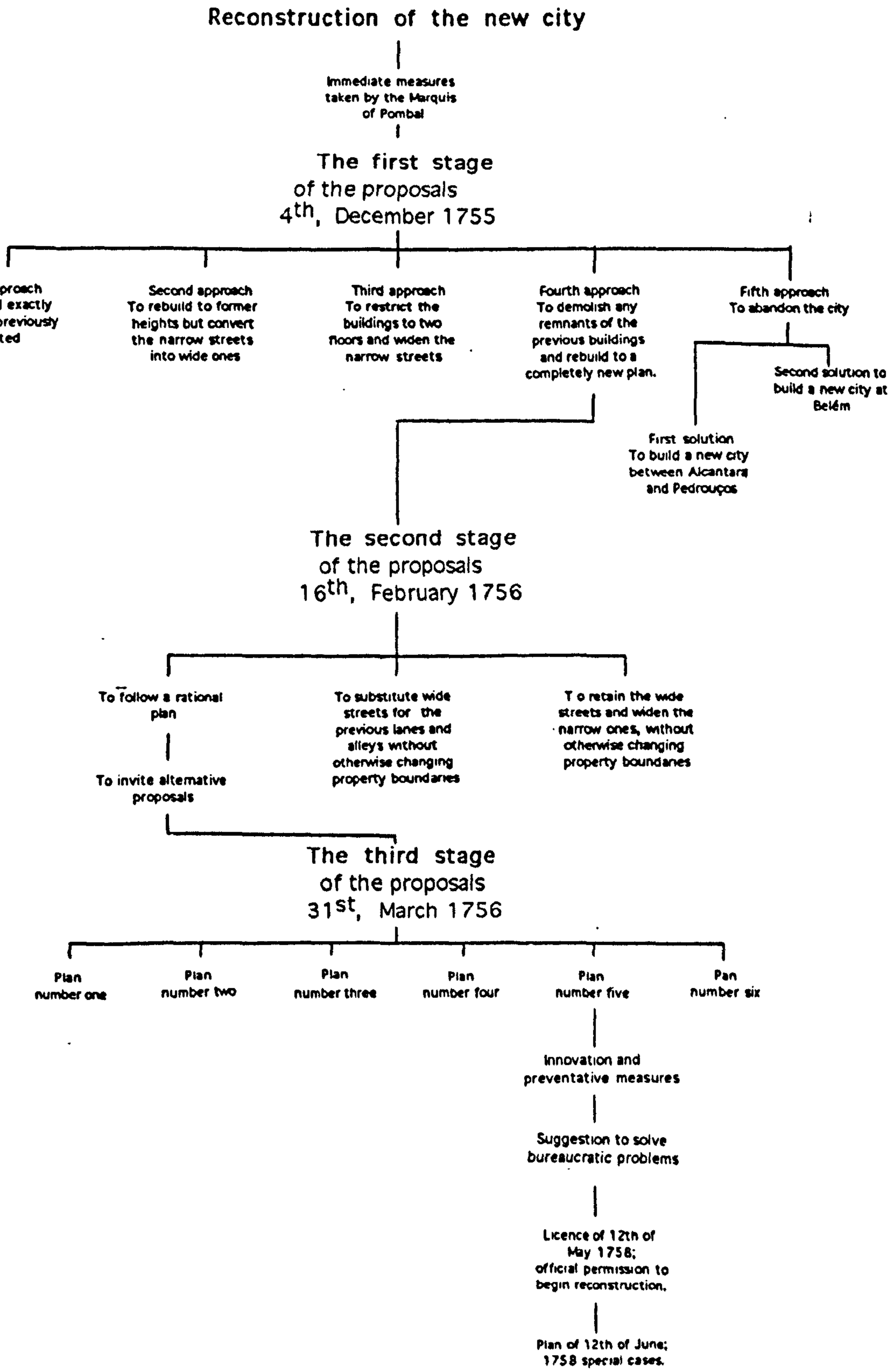


Fig.36-Flow chart showing Manuel da Maia's proposals for the reconstruction of Lisbon.

I.6.1.The first approach.

The first plan proposed to return the city to its former layout, rebuilding to the previous height and keeping the streets the same width (see Fig. 37). This first approach assumed that the earthquake which had occurred was not the forerunner of another. As there had not been an earthquake for many years, there was no reason to expect another one in the near future.

a)-Before the earthquake b)-The ruined buildings c)-After rebuilding.

Fig.37-The first approach proposed to return the city to its former layout.

There were distinct advantages in following, this approach. These were:

i) Lisbon could rapidly return to its former state.

ii) The improved buildings could accommodate the same number of people and permit landlords to obtain the same income from their properties.

iii) Lisbon could be slightly improved using the same material from the ruins for the rebuilding, cutting the work and the expense of clearing the area of rubble.

However there were also distinct disadvantages. These were:

i) If the city was to be rebuilt keeping its original narrow streets and very tall houses, there would be criticism that no advantage had been taken to improve the living conditions of the people.

ii) It would encourage a return to the former laissez-faire attitude to building lines and height.

I.6.2.The second approach.

In the second plan, it was proposed to rebuild to former heights but convert the narrow streets into wide ones. This second approach also ignored precautions against future earthquakes by maintaining the buildings at their original heights, (see Fig. 38).

a)-Before the earthquake: Narrow streets and heights more than two floors.

b)-After the earthquake: Widening of the streets

c)-After the earthquake: Building with the same heights.

Fig. 38-The second approach proposed just to convert the narrow streets into wide ones.

The advantages of doing this were as follows:

i) Better access to buildings could be achieved from street widening whilst still guaranteeing landlords most of their income.

i i) Improvements could be made to some of the biggest ruined buildings.

iii)The landlords could keep the same number of tenants and consequently receive the same income.

The disadvantages were:

i) While keeping the beauty of the city in mind, as far as the width of the streets was concerned, it did not pay sufficient attention to the problems of earthquakes, because it maintained the height of the houses.

I.6.3.The third approach.

It was proposed in the third plan to keep the heights of the buildings to three floors above the street level and widen the original narrow streets, (see Fig.39 on next page). This then had the advantages that:

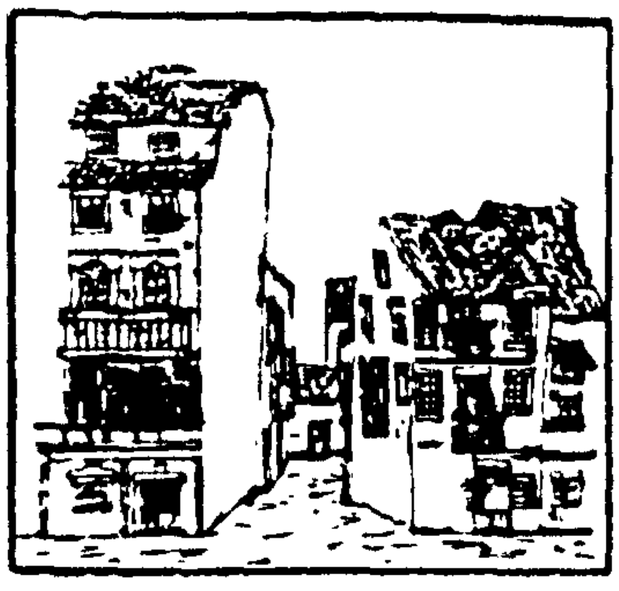
i) The limit on building heights was a precaution against earthquake damage.

i i) The advantages of wider streets improved appearance and access.

The disadvantages were that:

i) It did not please the owners of the ruined buildings as it would have meant lower incomes.

i i) Surplus rubble from the ruined buildings would have to be disposed of.



a-Before the earthquake

b-After the earthquake

Fig.39-The third approach to keep the heights of the buildings to three floors and widen the narrow streets

I.6.4.The fourth approach.

This involved using the rubble to create a new ground level and restricting the height of the buildings to the width of the streets, (see Fig.40).

The advantages of using this approach were:

i) Using the rubble to increase the level of the city, would improve the drainage of streets and properties. Also Lisbon would be protected against the flooding to which it was so often victim at high tide.

ii) Risk of future disaster from earthquake damage could be reduced by limiting the height of the buildings and the width of the streets.

The principal disadvantage was:

i) Problems of compensation to owners resulting from loss of income would still remain.

Fig.40-The fourth approach involved using the rubble to create a new ground level and restricting the height of the buildings to the width of the streets.

I.6.5.The fifth approach.

The fifth approach involved abandoning the ruined city of Lisbon, (see the possible places in Fig.41)

One proposal was to build a city from Alcantara to Pedrouços (see Fig.41) and give permission to houseowners in Lisbon to rebuild on the new site as they saw fit.

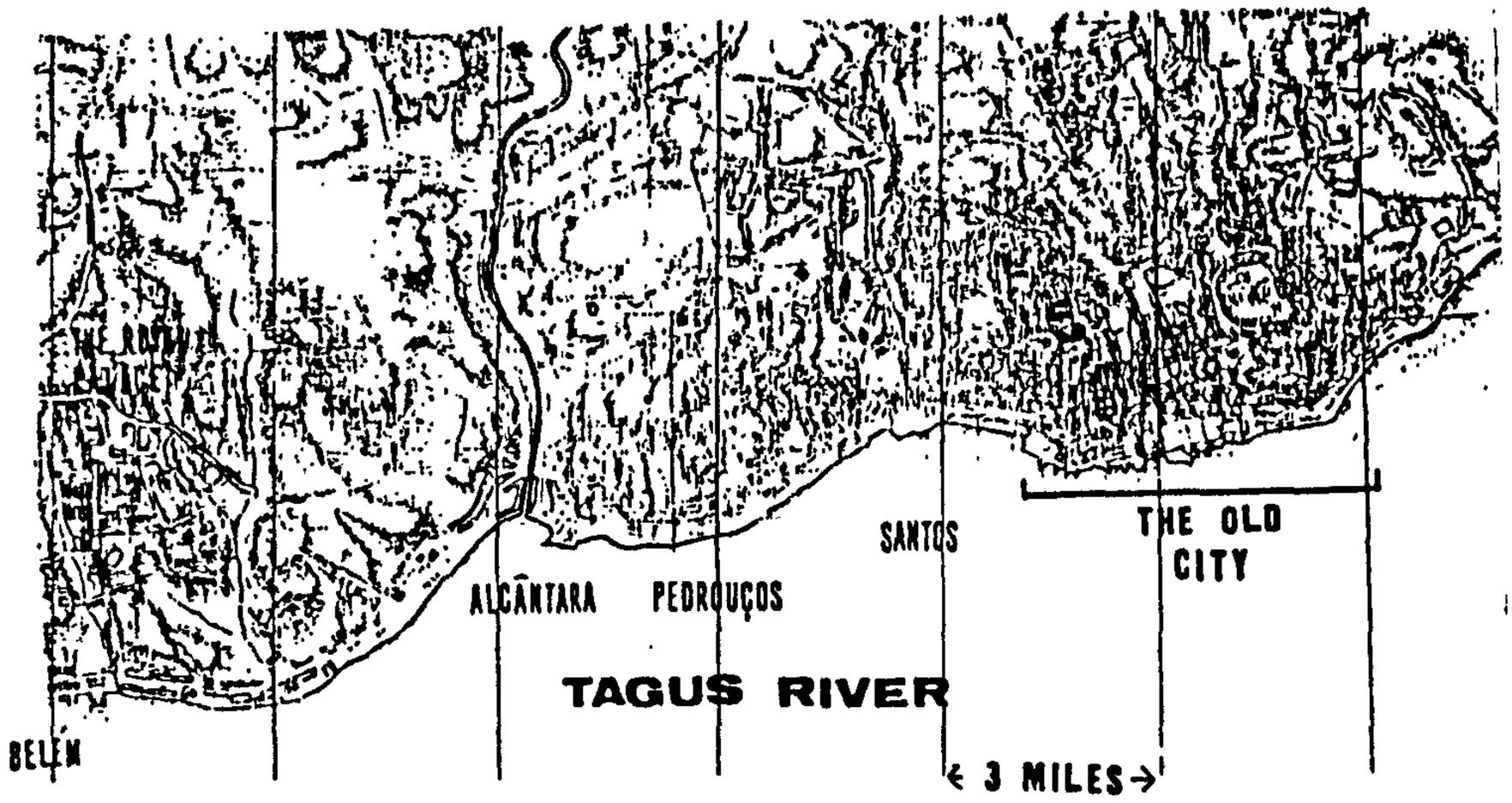


Fig.41-The old city, Alcântara and Belém.

A Second proposal was to build safer buildings on better land in Belém and its surroundings.

The advantages of building outside Lisbon´s walls were:

i) If the second, third or fourth approaches were adopted the widening of the streets and the reduction in the numbers of floors would mean that a large number of people would be homeless and would need temporary housing due to the shortage of accommodation. Gradually moving people into new permanent accommodation outside the old ruined city as it became available, would partly avoid this problem.

ii) This approach was supported by observations of what appeared to have happened in previous disasters. There were a number of examples of cities and towns in Portugal which had taken the names of previous ones that had been destroyed by earthquakes, but the original ruins could still be seen nearby without any obvious reason being apparent for the repetition of name.

iii) One curious reason given for a change of site was the conviction that earthquakes were magnified in heavily populated places due to the quantity of human excreta penetrating and permeating the earth below, thus producing more violent tremors and their effects producing more devastating results.

The advantages in moving to a new site were:

i) The new site would provide a flat area free from the problems inherent in old Lisbon and without the need to decide which buildings to keep or demolish. Also compensation and rental incomes would not be a problem.

ii) Without the need to clear and organise the congested site, the building of new Lisbon could be faster, without the landlords of old Lisbon having anything to complain about.

The main disadvantage of moving to a new site was:

i) It would be opposed by the owners of buildings in the main streets of Lisbon, who would be afraid that their incomes would be reduced by the building of more houses in different areas of Lisbon. They considered that creation of new centres as alternatives to the lower city would be against their interests.

I.6.6.The choice for the first stage of reconstruction.

To choose one of the five approaches, which was very difficult, it occurred to Manuel da Maia that if his Majesty were to choose the site for the new royal palace, this could help to reach a decision. The site which afforded better conditions than any other for the new palace was Belém, so the fifth approach would be the best one to choose in his opinion. His considerations took into account the fact that it was a healthier site, with good means of access to the country and was well levelled and had running water.

Manuel da Maia at this stage of the proposals, indicated some recommendations for the rebuilding of the city. The rebuilding, he suggested should start with the government buildings and then with rentable buildings. The streets of houses could be built partly in wood rather than completely in stone, and whitewashed. This form of construction would be faster and would overcome the public aversion to building totally in timber, due to their fear of fire.

The height of buildings would never exceed the width of the streets and even if some streets were wider than the height of two-storey houses above ground level, it would not be permitted to add a third storey, (see Fig.42). In these conditions, escape via streets in the event of any emergency would be made much more effective.

Fig.42-The height would never exceed the width of the streets

Fig.43-The arcades should be built in the main streets

To be able to make the streets as straight as possible, all the destroyed streets would be marked out with flags in order to show where the original streets and houses had been. Also arcades should be built in the main streets of the flat lower area, as there used to be in the street of Nova dos Ferros and Confeitaria street, (see Fig.43).

This would provide greater public comfort and convenience on rainy winter days.

It was also necessary to allow sufficient passage of time, in order that the great number of corpses buried under the rubble did not produce unacceptable odours when uncovered. For the same reason, it was recommended that the level of the streets was raised to avoid the necessity of turning over the rubble. In the first part of his proposals, Manuel da Maia had tried to give a general outline of the approach to take account of criticism and willingly listened to suggestions for amendment.

After consideration of the proposals, his Majesty decided to build the new Royal Palace at Belém but, as far as the city was concerned, he decided to build the main body of the destroyed city in accordance with the fourth approach.

I.7. The second stage of the proposals by Manuel da Maia for the reconstruction of Lisbon.

I.7.1. The possible methods of carrying out the reconstruction.

Seeing that the first part of his proposals for the rebuilding of the city was well received, Manuel da Maia produced the second part of his plan in which he considered important questions relating to the legal and financial aspects and also the details of how to proceed.

For the renovation of lower Lisbon, Manuel da Maia suggested three possible approaches, which were:

i) Completely razing Lisbon to the ground and rebuilding it following a rational plan (see Fig.44).

Fig.44a-How a new street could be envisaged.

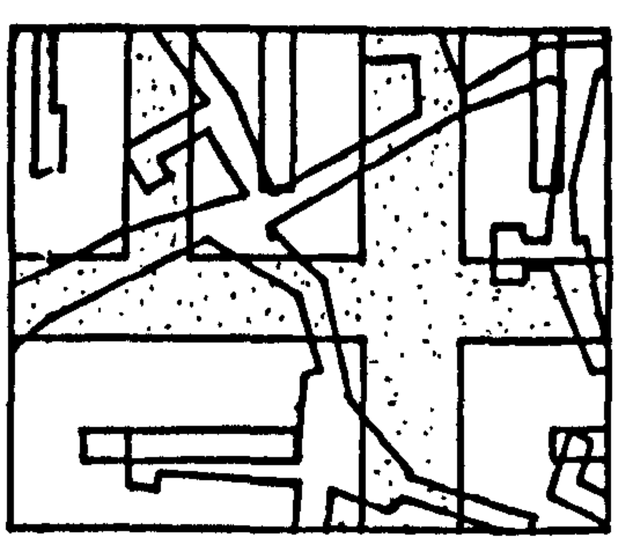


Fig.44b-A new rational plan over the medieval plan.

ii)Razing Lisbon but keeping the wide streets and widening the narrow ones, (sse Fig.45).

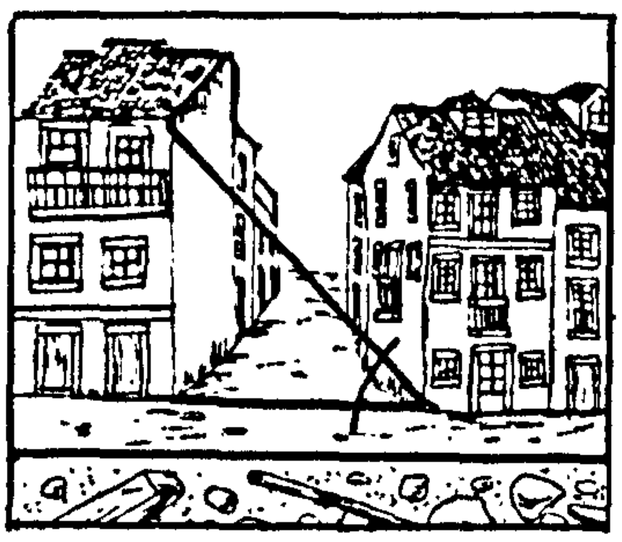


Fig.45a-Rebuilding the same properties.

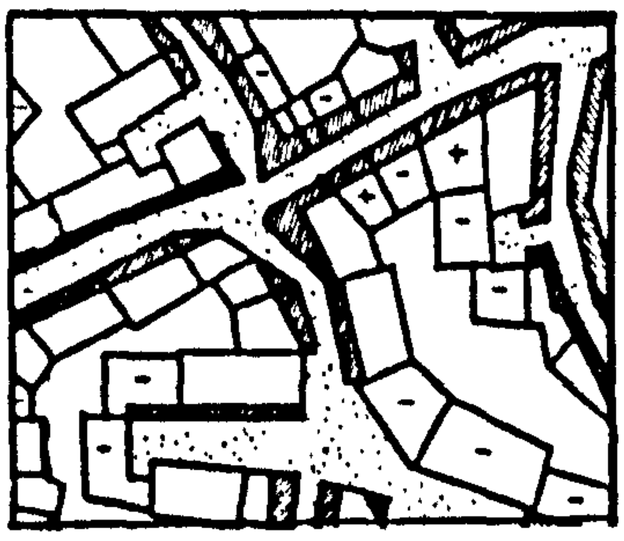


Fig.45b-Widening the narrow streets.

iii)Not razing Lisbon, just changing the alleys and lanes into wide streets, (see Fig.46).

Fig.46a-Rebuilding the same buildings.

Fig.46b-Changing the alleys and lanes into wide streets.

The new streets formed by widening the narrow streets, reducing the alleys and lanes and also correcting the irregularities on many houses, would have created difficult problems with adjustments and compensation. These would make these innovations more of a problem than an advantage so the first approach was the one which he recommended.

I.7.2. The ideal method for redistribuition of land and property.

If renovating lower Lisbon was essential, what remained to be decided was the best way to achieve this objective. Da Maia admitted to having some difficulties in devising the second stage of his plan, because when he outlined the fourth approach to renovation, which included razing lower Lisbon to the ground, it was in the expectation that his Majesty would first choose to take over all the buildings in this part of the city and evaluate whatever was left of them. After they had been completely razed to the ground and new streets and buildings had been planned, the value of the destroyed houses could be divided by the number of plots, after all the measurements had been taken, and each owner could receive in land the value attributed to his property.

In cases where the owners refused the land, it could be sold and the money given to the owner instead or, if doubts of ownership still existed, his Majesty could finance the rebuilding and the income from the new buildings could be vested in favour of the crown.

This solution, which is illustrated in Figure 47 seemed to be the most fair and effective way in which to proceed. However, it was not easy to apply, because the fire had destroyed a part of the National Archive, in which was included a catalogue of the city buildings and their valuations.

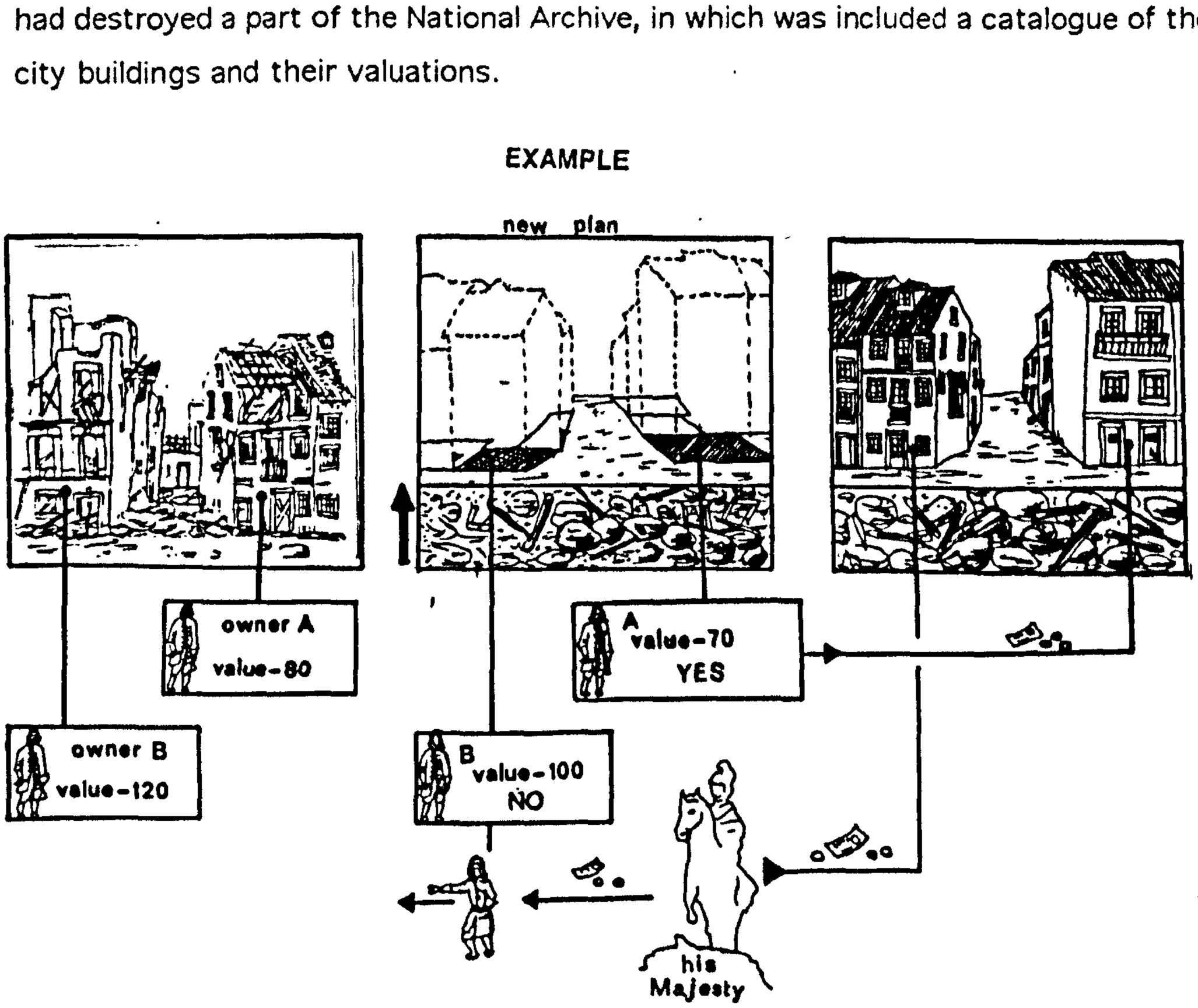


Fig.47-The ideal renovation.

To reform the lower city in the way indicated in the first of the three approaches all the churches, convents and chapels had to be roughly in the same place and of the same size.

Determination of the value of property in the newly rebuilt city was done in the following way:

If the total floor area of all the old city property was A and the total purchase price of all the old properties was V, then the valuation factor F for the old city (i.e. cost/unit area of property) is F=V/A, this could be estimated.

If the total floor area of the planned new city buildings is A' and the total purchase price for all the new buildings is V' then the valuation factor F' for the new city (i. e. cost/unit area) is F'=V'/A'.

However the total value of the new buildings is taken as equal to the total value of the old buildings i.e. V=V'.

Therefore F´A=FA' and the valuation factor for the new buildings, F´, is then given as FA´/A.

Once the valuation factors F and F' had been determined it was relatively simple to determine what each person´s entitlement was in terms of area of new property and what remuneration or additional costs would be attributed to them if they were not allocated exactly their official quota.

Depending on the value of the demolished houses, the owner could receive on the new plan the equivalent number of square palms of land, having in mind the relation between the old plan and the new.

Also in an attempt to give each owner the same type of site that he had had before, the ones with sites near the sea, for example, would be given another site close to the sea, the ones with sites near the Rossio would be given sites near there and so on.

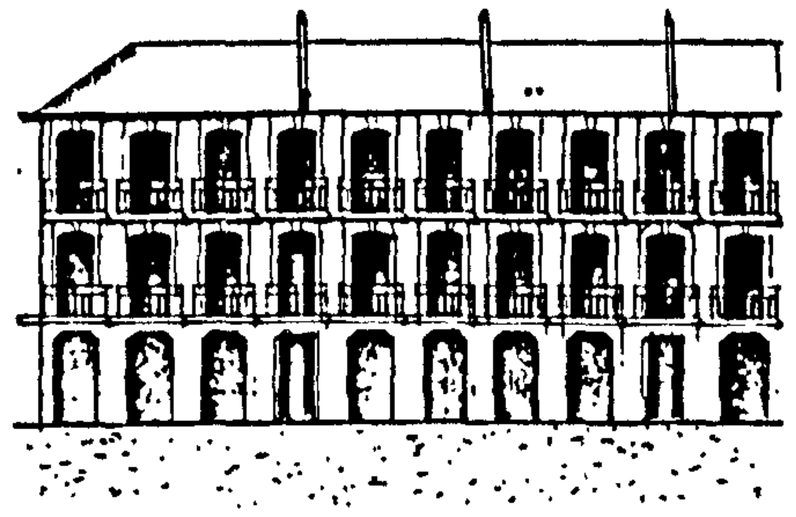
I.7.3. The buildings in accordance with the reconstruction.

Lower Lisbon was the commercial and trading centre of the city and had previously consisted of shops with accommodation for workers, traders and merchants. The new plan was aimed at standardising this type of accommodation in order to provide a much more effective and efficient environment and infrastructure.

The buildings were to be constructed in accordance with plans produced by the Senate Architect Cap. Eugénio dos Santos, so that each street maintained the same symmetry with respect to doors, windows and heights.

As far as height was concerned, the shops would be at ground floor level with two storeys above the shops, for living, (see Fig.48). The walls dividing the different houses would be higher than the fronts as protection against fires which easily pass from one roof to another if this practice is not followed.

Fig.48-The buildings proposed



Eugénio dos Santos suggested that each street or each quarter would have some distinctive feature, in for example its colour. However, the lower city was to be entirely in the same colour in order to distinguish it from the other parts of the city.

Making the houses symmetrical and as standard units, would make the task of relating the old properties to new ones a much simpler process.

Once the siting of the new buildings had been determined on the new plan, with the correct symmetry, it would be necessary for them to be put up for sale. They could first be offered to the creditors on the following conditions:

i) If a creditor received a new site that was more valuable than the one that he had owned, he would have to pay the difference in cash to satisfy other creditors, (see Fig.49).

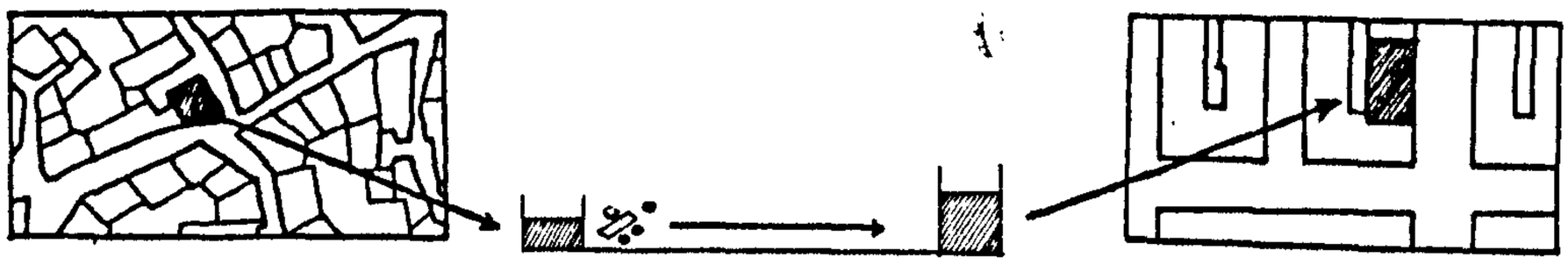


Fig.49-Process of selling properties, 1.

i i) If a creditor received an area of less value than that which he had previously owned, he would be compensated by receiving in cash the difference in value between an equivalent area of new site and the actual area, (see Fig.50).

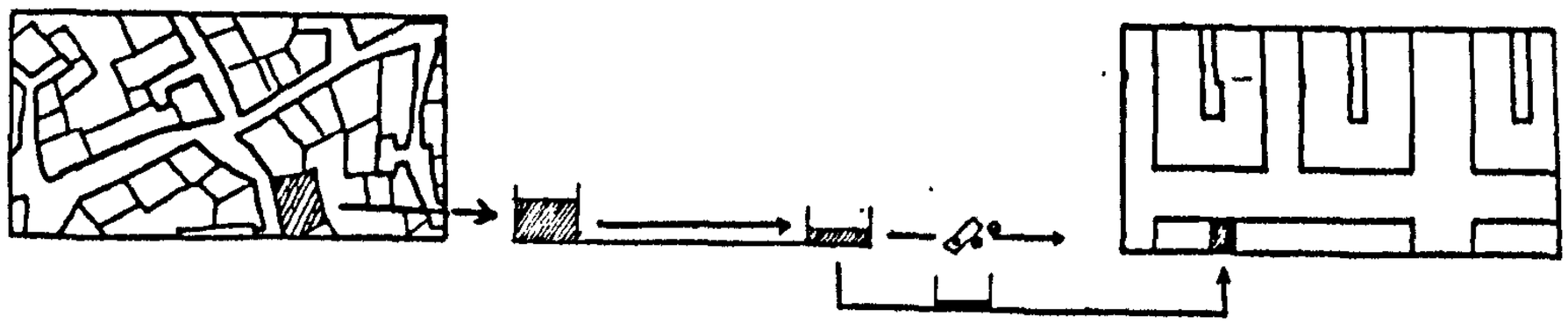


Fig. 50-Process of selling properties, 2.

iii) If there were areas which the creditors did not wish to purchase these would be sold to non-creditors so that the creditors would receive in cash what was due to them, (see Fig.51).

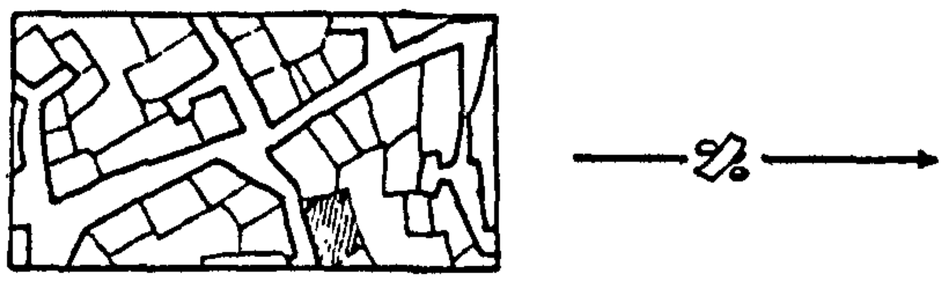


Fig. 51-Process of selling properties, 3.

iv) If there were creditors who wished to purchase much larger areas than they had previously owned, they were allowed to negotiate with other creditors who wanted cash rather than property, (see Fig.52).

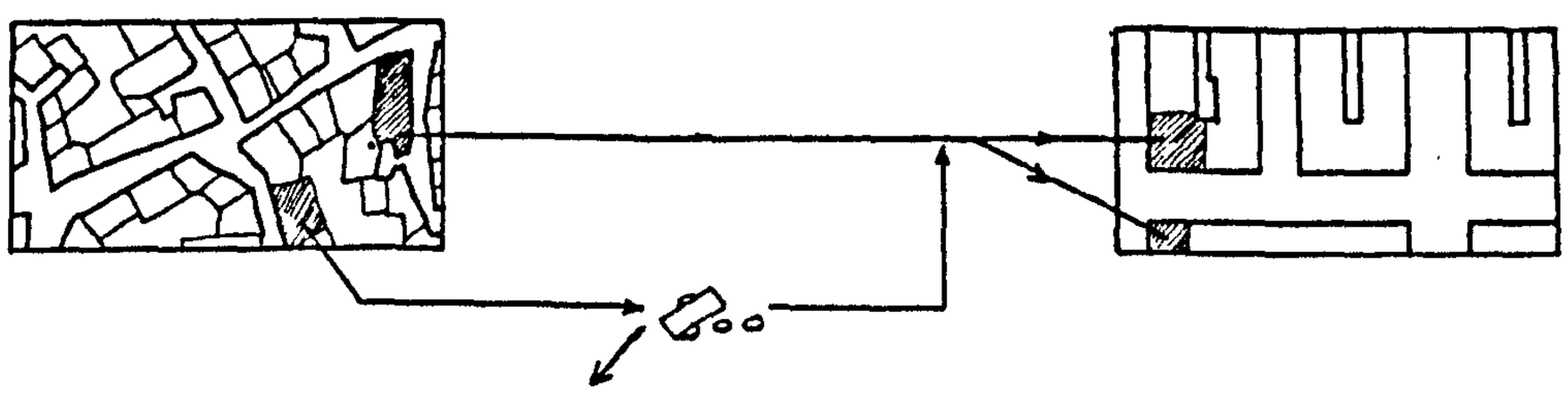


Fig. 52-Process of selling properties, 4.

In order to overcome the fear of there not being anyone to buy some of the areas or of creditors not accepting them in exchange for those that they had lost, it occurred to Manuel da Maia that he should persuade the King to start the rebuilding of Lisbon with those buildings which were to be built with Royal Treasury funds. Then because it was very convenient for businessmen to have their homes near the public buildings, that would encourage the businessmen to also start rebuilding. Such an attraction would make the rebuilding of Lisbon much easier with the advantages already discussed of razing it to the ground and completely rebuilding.

I.8. The third stage of the proposals by Manuel da Maia for the reconstruction of Lisbon.

I.8.1. The plans presented for the reconstruction.

Due to the high priority given to rebuilding the destroyed area of the city, which was the economic centre and the traditional commercial sector, three teams were constituted which prepared a total of six draft versions superimposed on the old city plan (2, 20, 21).

Manuel da Maia felt that the churches and chapels should be rebuilt on their previous sites, with the land that had previously belonged to them (2, 20, 21).

An area within the new plan was to include a seaward extension of the Terreiro do Paço, formed by raising the level of the land with material from demolished buildings.

These rules applied only to three teams; more freedom was given to the teams of Captain Eugénio dos Santos (2, 20, 21).

All the six plans presented, had tried to preserve the Rossio and Comércio Squares.

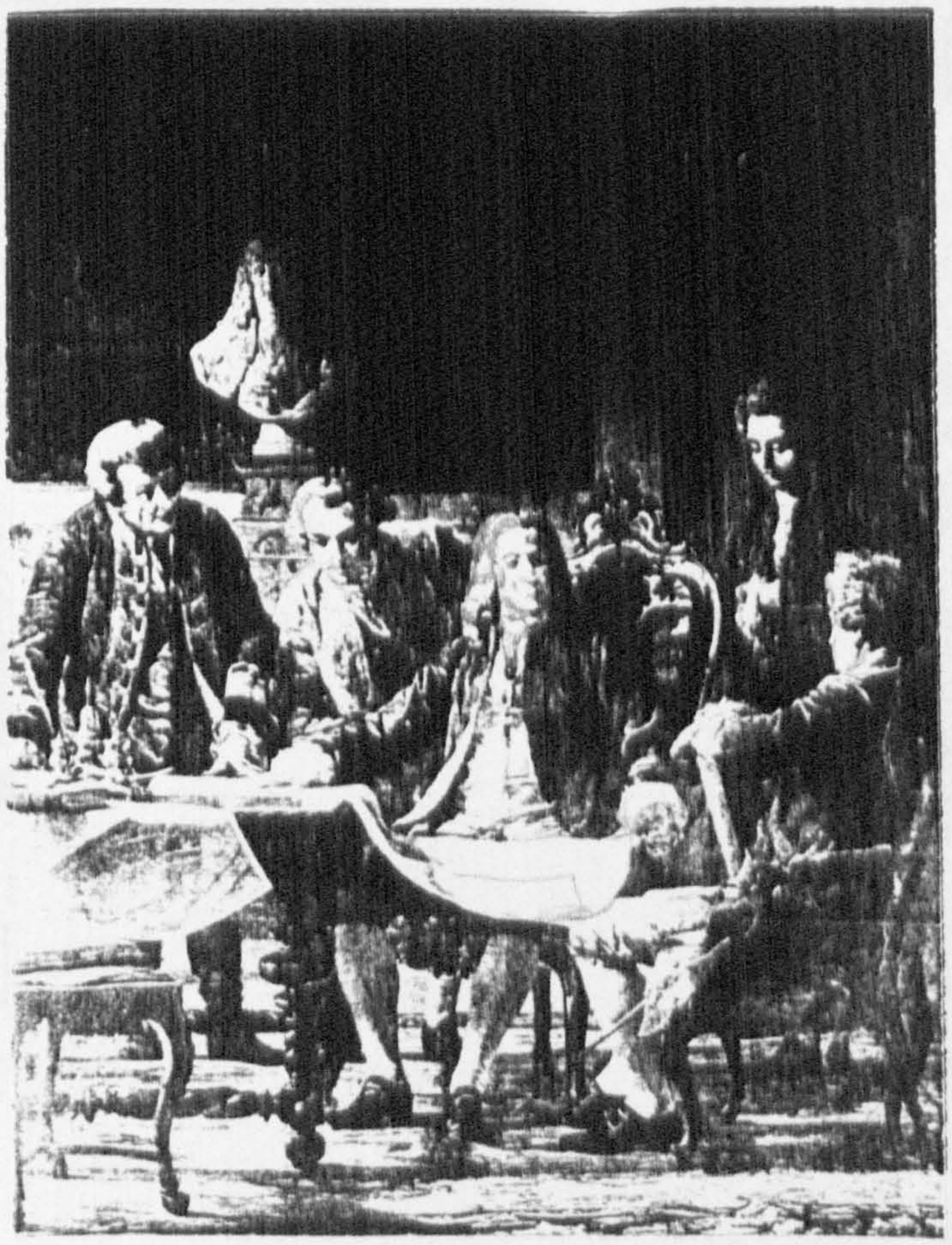


Fig.53-The Marquis of Pombal discussing the plans.

The Assistant Architect Pedro Gualder da Fonseca, helped by the practitioner (articled pupil of Architecture) Francisco Pinheiro da Cunha, was given the task of preparing a plan (known as plan number one, see Fig.54), for the lower part of the area that had been destroyed. This included widening and straightening the narrow streets with minor improvements to the wider ones, and in some cases the extension of dead ends to link with other streets. It was expected that this plan would emphasise the need for these types of improvement [2, 20, 21]. Maintaining many of the features of the surrounding areas did not present problems of transition or conflict with them.

An important aspect of this plan was that the building of the stock-exchange occupied the centre of Praça do Comercio [2, 20, 21].

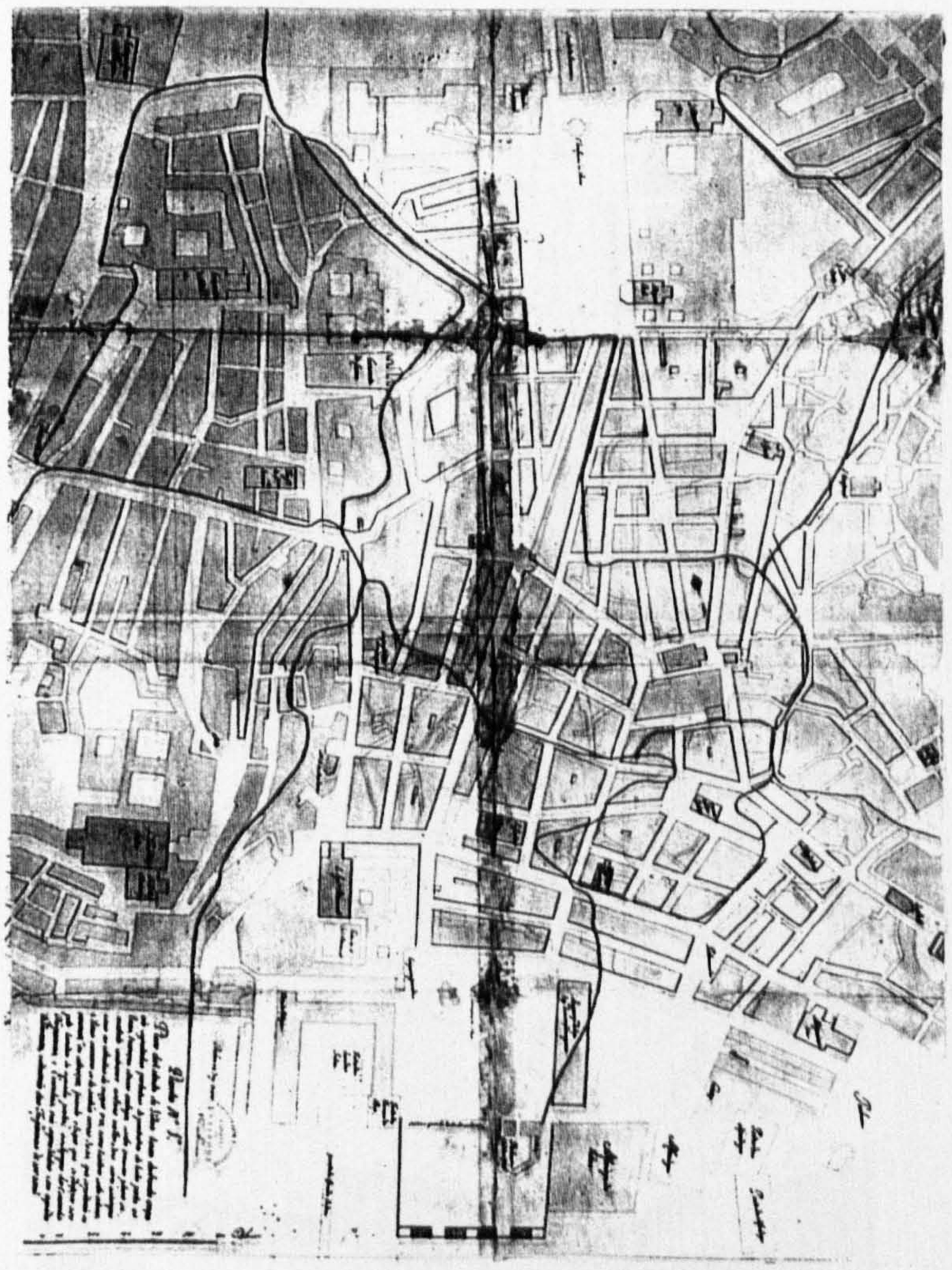


Fig.54-Plan number one.

Captain Elias Sebastião Poppe (architect), helped by his son, Jose Poppe (articled pupil of architecture), was asked to prepare another plan (known as plan number two). In this plan the narrow streets were not to be widened; and Captain Poppe was given the freedom to decide on the extent of alteration of the street lay-out which he considered appropriate (2, 20, 21).

The plan presented (see Fig.55) was a grid plan but it maintained the existing sites of the churches. It had three streets running from Rua Nova dos Ferros towards Rossio. One of the streets ended at the midpoint of one of the sides of the square, accentuating its symmetry. Five east-west streets crossed the set of north-south ones, while another three ran slightly obliquely to Rua Nova dos Ferros. The Comércio Square was parallel to the river and only one street ran from Rossio to Comercio Square. This plan also did not present problems of transition or conflict with the surrounding areas.

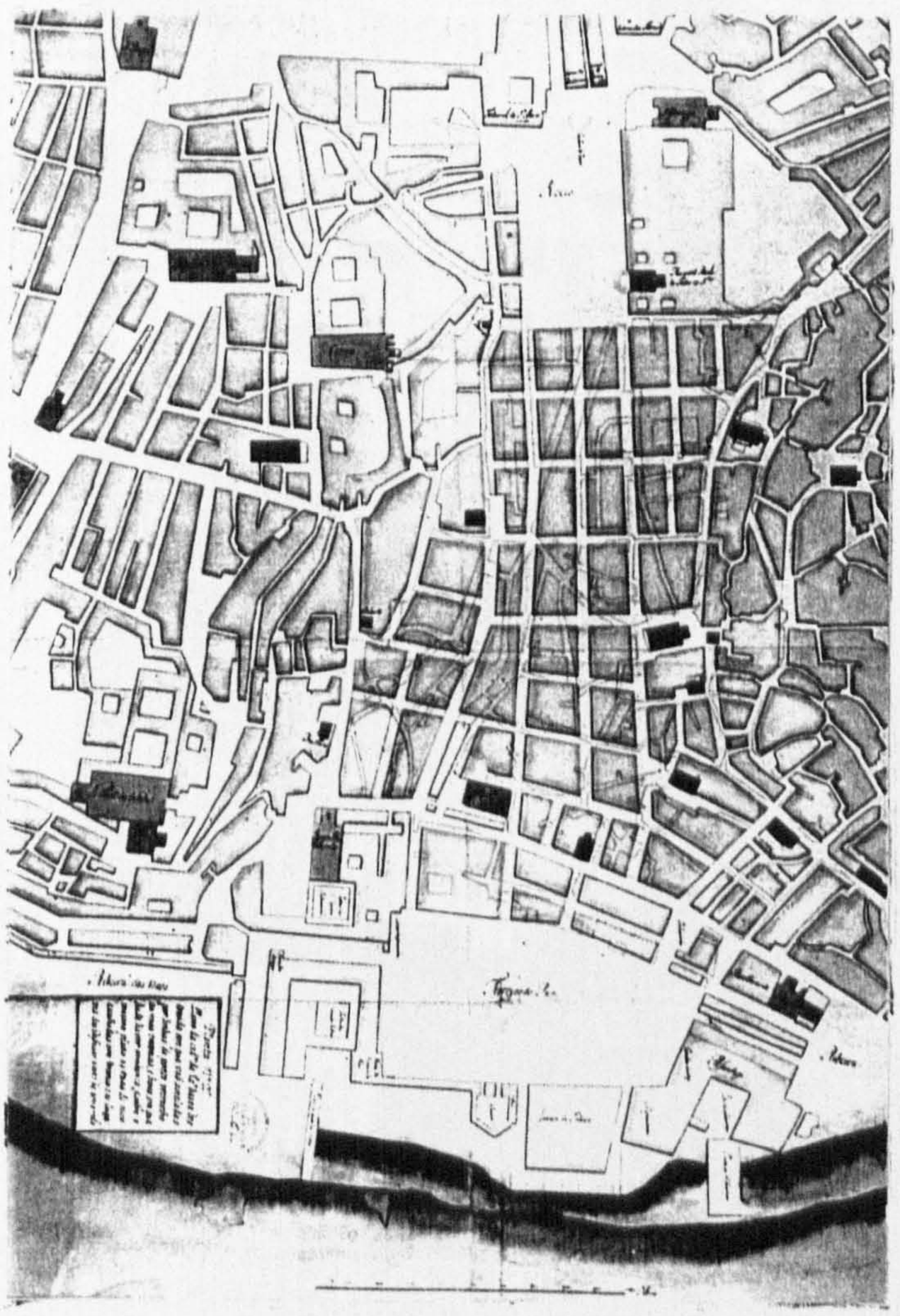


Fig. 55-Plan number two.

Captain (also Architect) Eugenio dos Santos de Carvalho , assisted by Antonio Carlos Andreas (Assistant Architect), was commissioned to prepare another plan (known as plan number three). He was free to plan as he wished. It was recommended that squares should be built on sites considered convenient, so that the inhabitants of the new city could enjoy the benefits of the open air. The result was a rational plan, (see Fig.56) [2, 20, 21]. "Rua Nova dos Ferros" was respected in its location. It articulated the "Terreiro do Paço" and Rossio Square with three major thoroughfares. There was planned a new square as central space of the entire plan. The grid was adjusted to the dimensions of the squares and in particular to the new shape of the Terreiro do Paço. Consequently the blocks were elongated with their longer sides running approximately north-south.

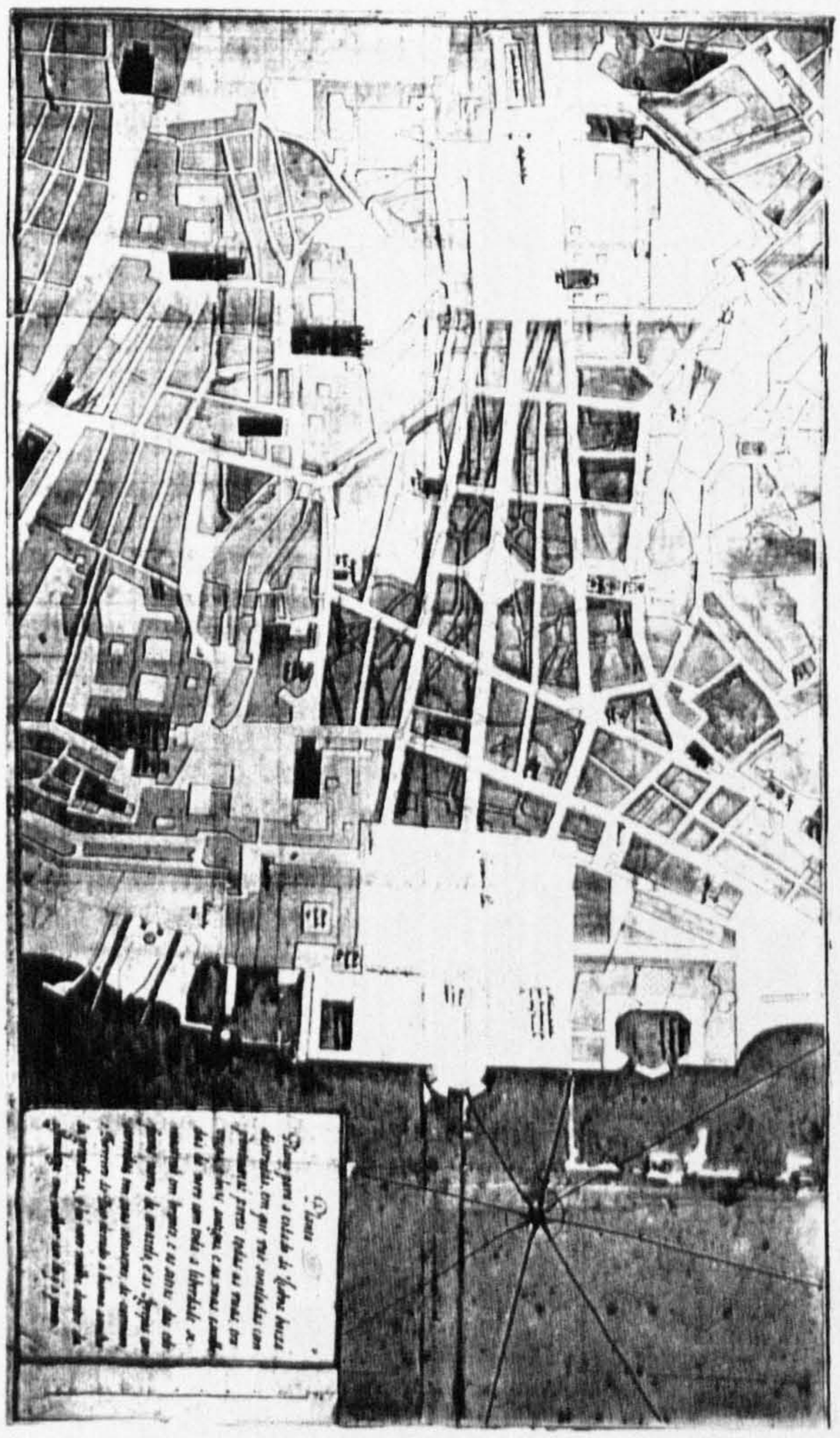


Fig. 56-Plan number three.

A second plan prepared by Assistant Architect Gualder da Fonseca, (known as plan number four), consisted of an orthogonal grid of streets oriented in the north-south and east-west directions, (see Fig.57) [2, 20, 21]. It was a rigid grid of eleven streets crossing five east-west ones. The dimensions of the Terreiro do Paço were reduced compared with the previous square. It had some squares, including S. Nicolau, a square placed diagonally at the centre of the composition. In spite of providing many linear metres of façade of high commercial value, it did not possess the healthy living conditions which were regarded as essential. The grid had very elongated blocks and probably this contributed to its failure. The plan appeared to conflict with the surrounding areas.

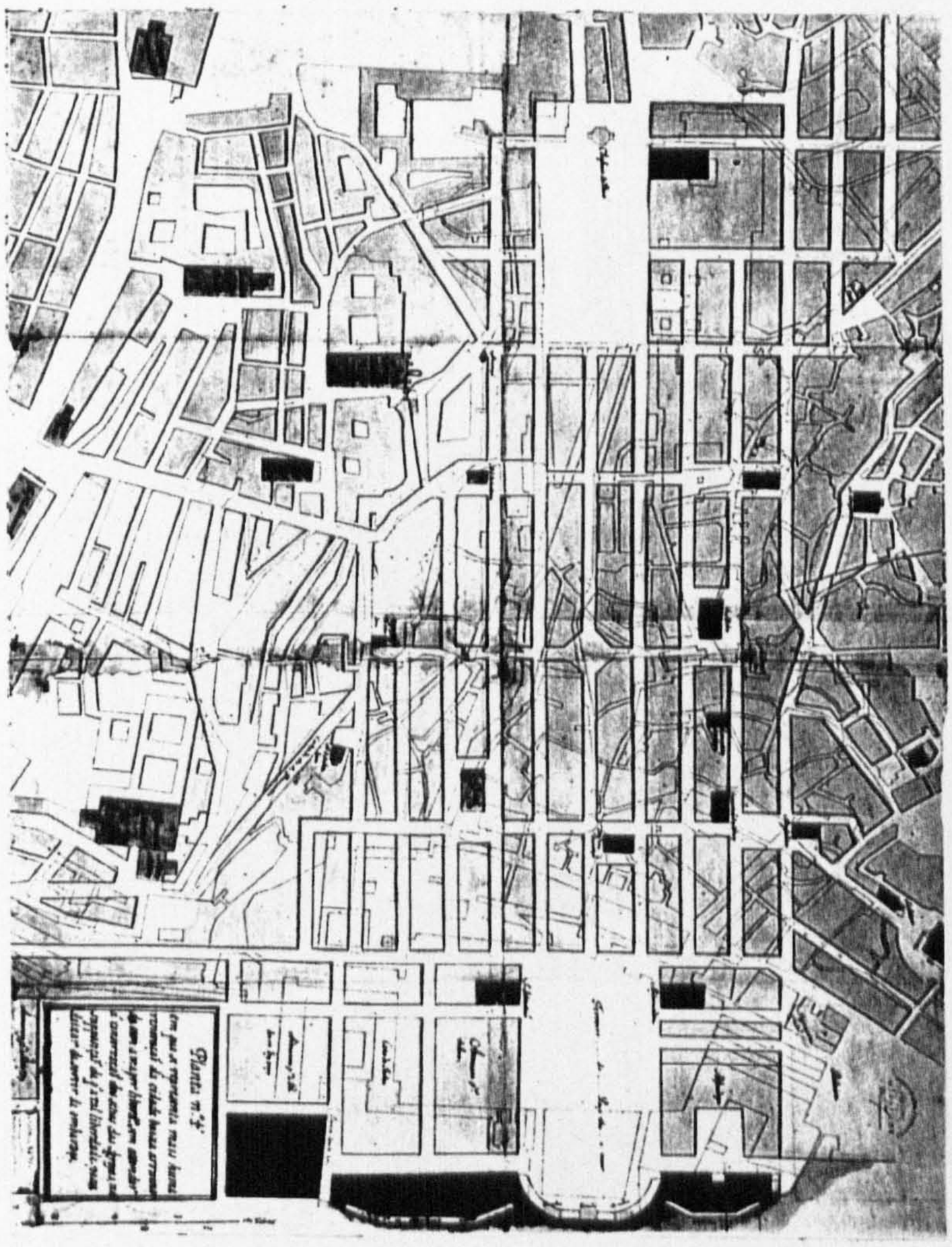


Fig. 57-Plan number four.

The second plan prepared by Captain (also Architect) Eugénio dos Santos (known as plan number five) did not maintain the churches on their original sites. It consisted (see Fig.58), of an orthogonal grid with eight streets, perfectly parallel and rectilinear, oriented in the north-south direction, giving accesses to Comércio Square. Nine streets cross orthogonally in an east-west direction, and the main ones are the three near the Comércio Square, which run parallel to the old Rua Nova dos Ferros (2, 20, 21). There were transitional areas which are bounded by the edges of flat land where the Madalena and S. Francisco hills begin.

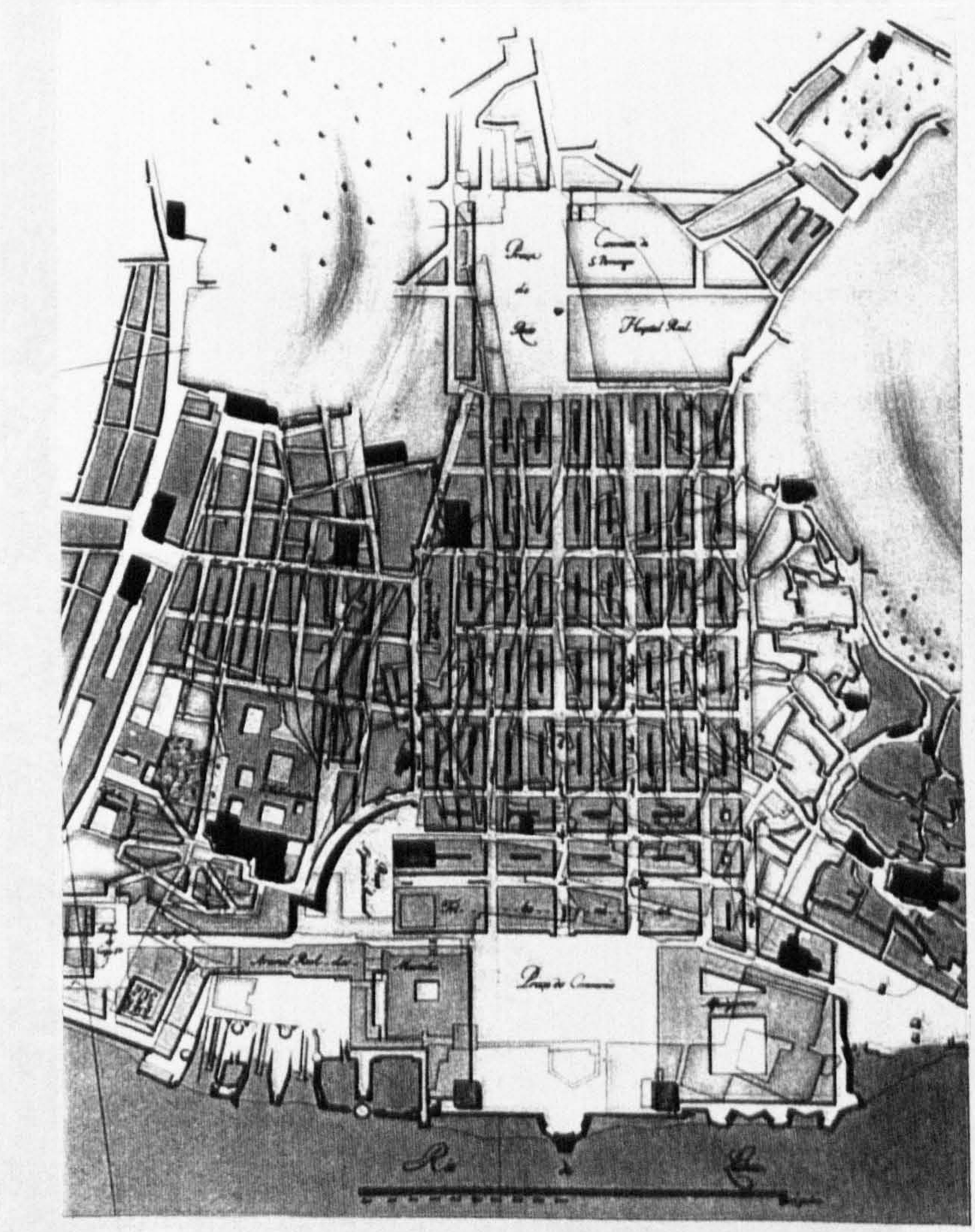


Fig. 58-Plan number five

The final plan, known as plan number six (see Fig.59), prepared by Captain Elias Sebastião Poppe (also Architect), did not maintain the original sites of the churches. It consisted of an orthogonal grid, composed of eight north-south streets and eleven east-west ones. Three streets led off from the north side of the Terreiro do Paço square and a different three led off from the south side of the Rossio square. An intermediate square of an irregular hexagonal shape was proposed, with S. Nicolau Church in its centre. An important feature of this project was that the Terreiro do Paço, was planned as an enclosed square with the Bolsa (Stock-Exchange) and the Customs office on its west side [2, 20, 21].

This plan was considered to be insufficiently commercial. The small square blocks of which it was composed, wasted too much land by its extensive repetition.

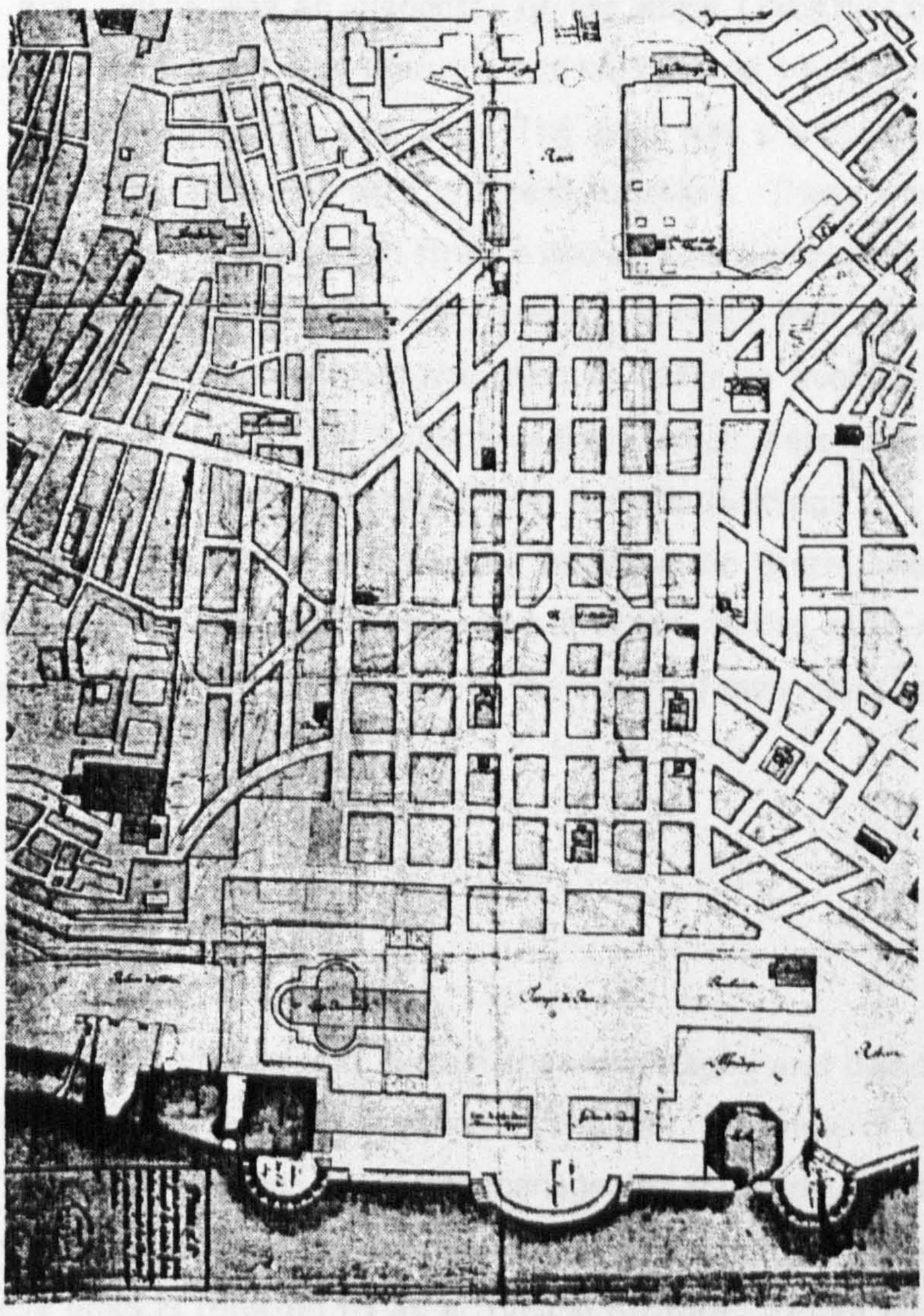


Fig. 59-Plan number six.

Of the six plans the one chosen was plan number five prepared by Captain Eugenio dos Santos (see Fig.60). This project offered a large number of commercial façades with high density. This satisfied economic interests but also took account of the need for secure and healthy conditions for tenants.

Fig. 60-The Captain Eugénio dos Santos.

Eugénio dos Santos was an inspector of the Royal Construction works and an Architect of the Senate. His high standing and background could well have influenced Manuel da Maia, in choosing this plan. The plan was particularly successful in integrating two separate areas with different functions. These were the Comercio Square which formed the new administrative and commercial quarters, and the Rossio Square with its meeting place and daily social functions. Part of Comércio Square would occupy land reclaimed from the river. In order to avoid fires the scale of churches was reduced, and the public buildings which were concentrated in the Comércio Square were clearly separated from rentable buildings.

Most of the blocks, with the exception of Comércio Street, were oriented in a north-south direction, precisely in the same direction as the earth movements (and the same as the flow of the alluvium), with the object of minimising the effect of earth tremors.

I.8.2. Comparision of the six plans

In order to fully compare and explain the advantages and disadvantages of the different projects for the reconstruction of the city, a sample of the whole area is considered. The plan is broken down into manageable areas of 10 000 square metres, (100x100m), the use of which is common practice in Portugal for economic studies. Each of these units is referred to as a "typical hectare". Figure 61 shows a typical hectare located on a plan of the reconstructed Pombaline area, Figure 62 shows this "typical hectare" with the old city plan superimposed and Figure 63 shows that part of the old city plan contained within the typical hectare. Figure 64 shows a three dimensional plan of the buildings prior to the earthquake.

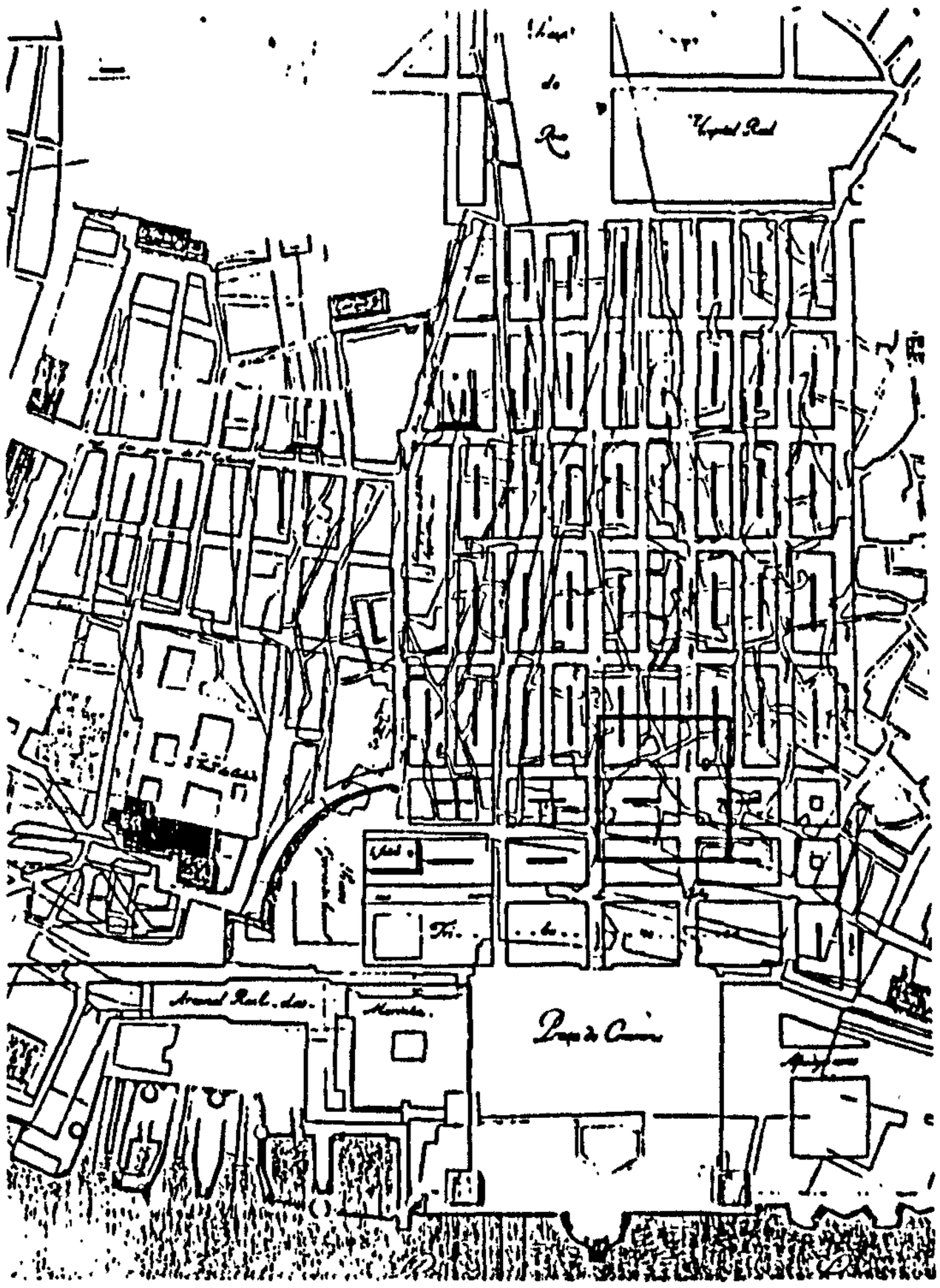


Fig.61-The "typical hectare", location on the approved plan.

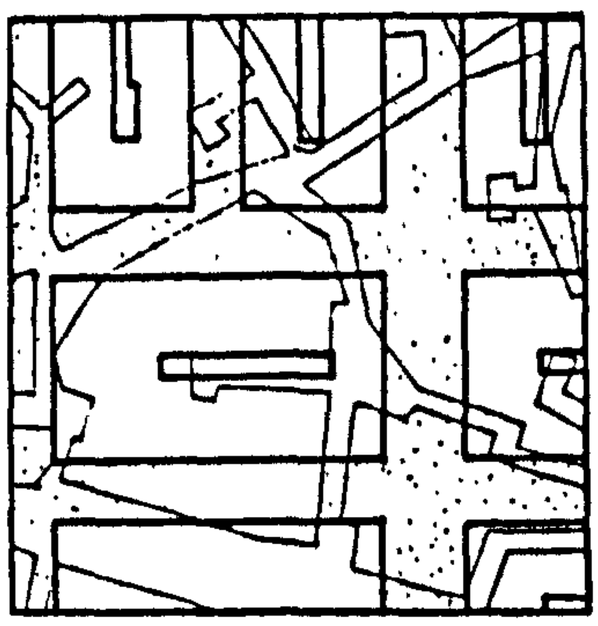


Fig.62-The "typical hectare", over the approved plan.

Fig.63-The "typical hectare", superimposed on the old city plan.

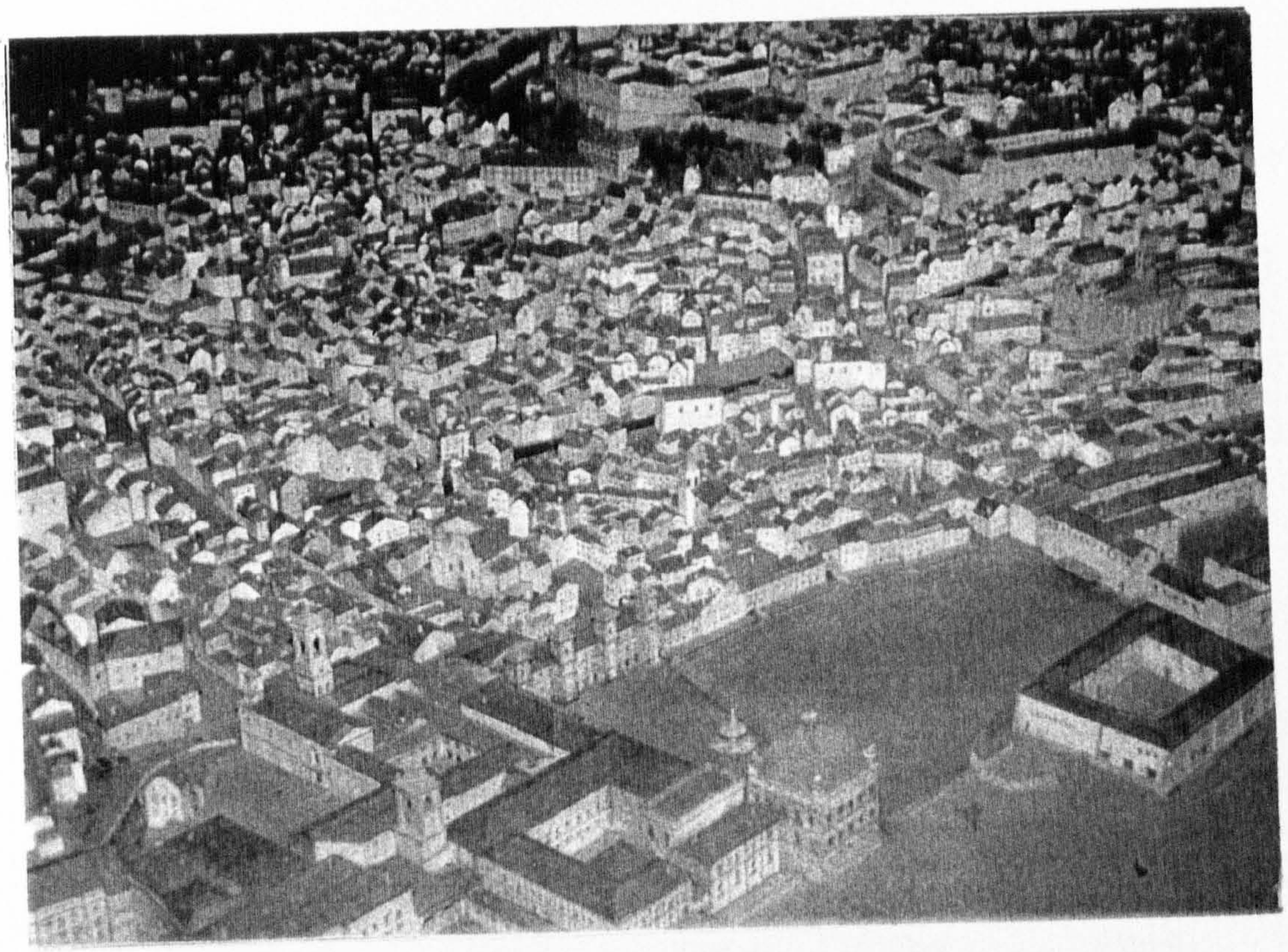


Fig.64-Lisbon before the earthquake.

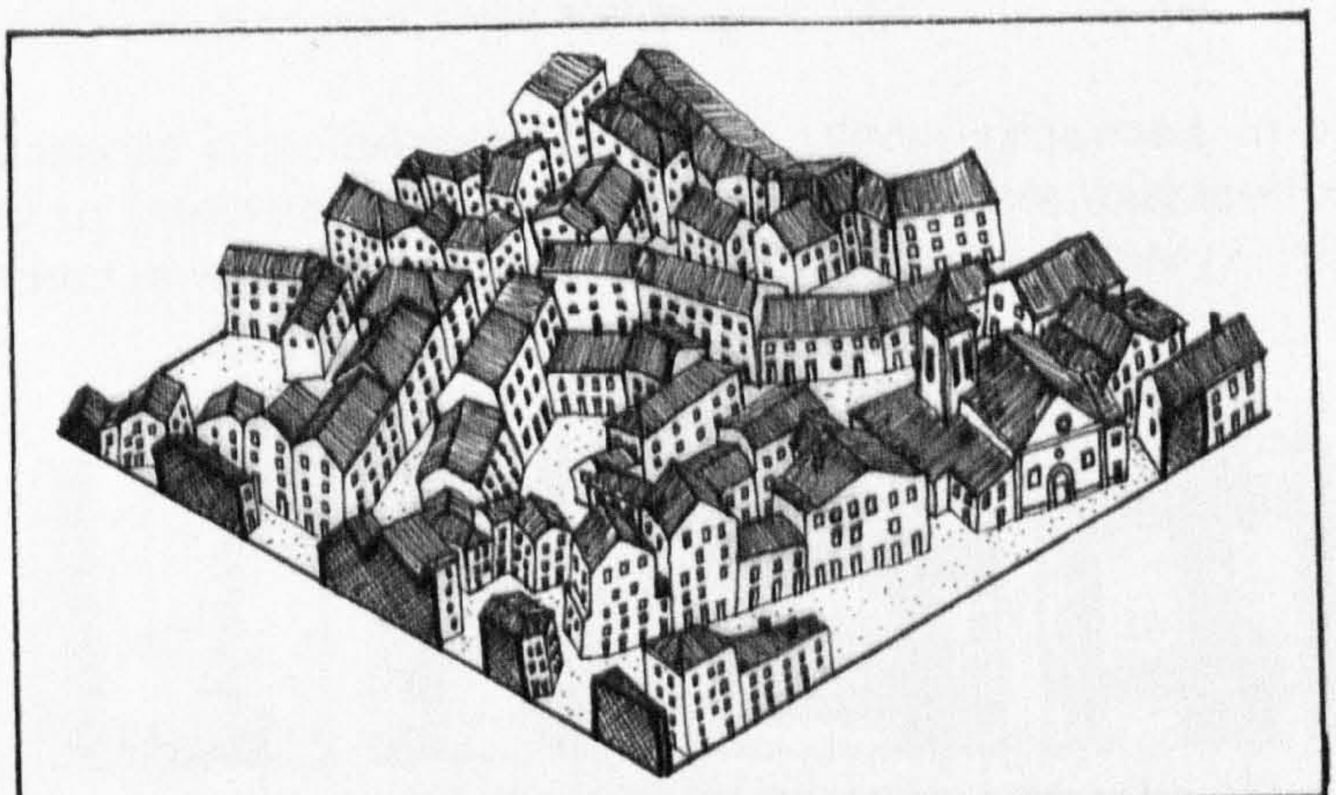
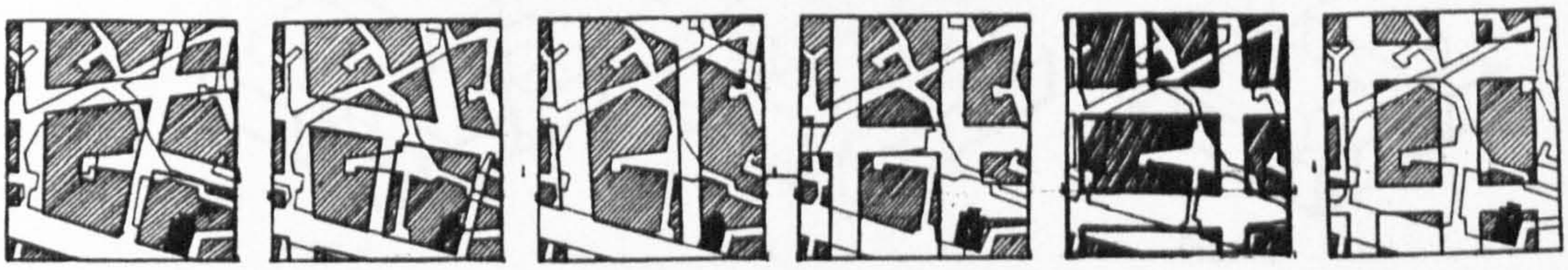


Fig.65-Perspective of the "typical hectare".

Fig.66-View inside the"typical hectare," before the earthquake.

The figures below are comparisons between the six plans using a selected typical hectare.

In plans one, two and three there seemed to be more coincidence of building areas between the proposed plans and the original plan (see Fig.67).



Plan 1 Plan 2 Plan 3 Plan 4 Plan 5 Plan 6

Fig.67-Coincidence of building areas between proposed plans and original plan.

Plan one tried to respect the previous streets, plans two and three, just the important ones. The remaining plans ignored the old streets (see Fig.68).

Plan 1 Plan 2 Plan 3 Plan 4 Plan 5 Plan 6

Fig.68-Coincidence of streets between proposed plans and original plan.

In plan one, the previous blocks coincide more often with those proposed, in plan six large areas were devoted to the proposed streets, plan five is more balanced and there was not a great difference in width between the main and the secondary streets (see Fig.69).

Plan 1 Plan 2 Plan 3 Plan 4 Plan 5 Plan 6

Fig.69-Relative predominance of streets between proposed plans and original plan.

In the approved plan (number five), all blocks had *alfugeres* (courtyards) in order to avoid internal rooms (see Fig.70).

Plan 1 Plan 2 Plan 3 Plan 4 Plan 5 Plan 6

Fig. 70-Showing hatched are the unventilated and internal rooms of the proposed plans.

As is shown in the perspectives (see Fig.71), the approved plan had blocks of regular shape.

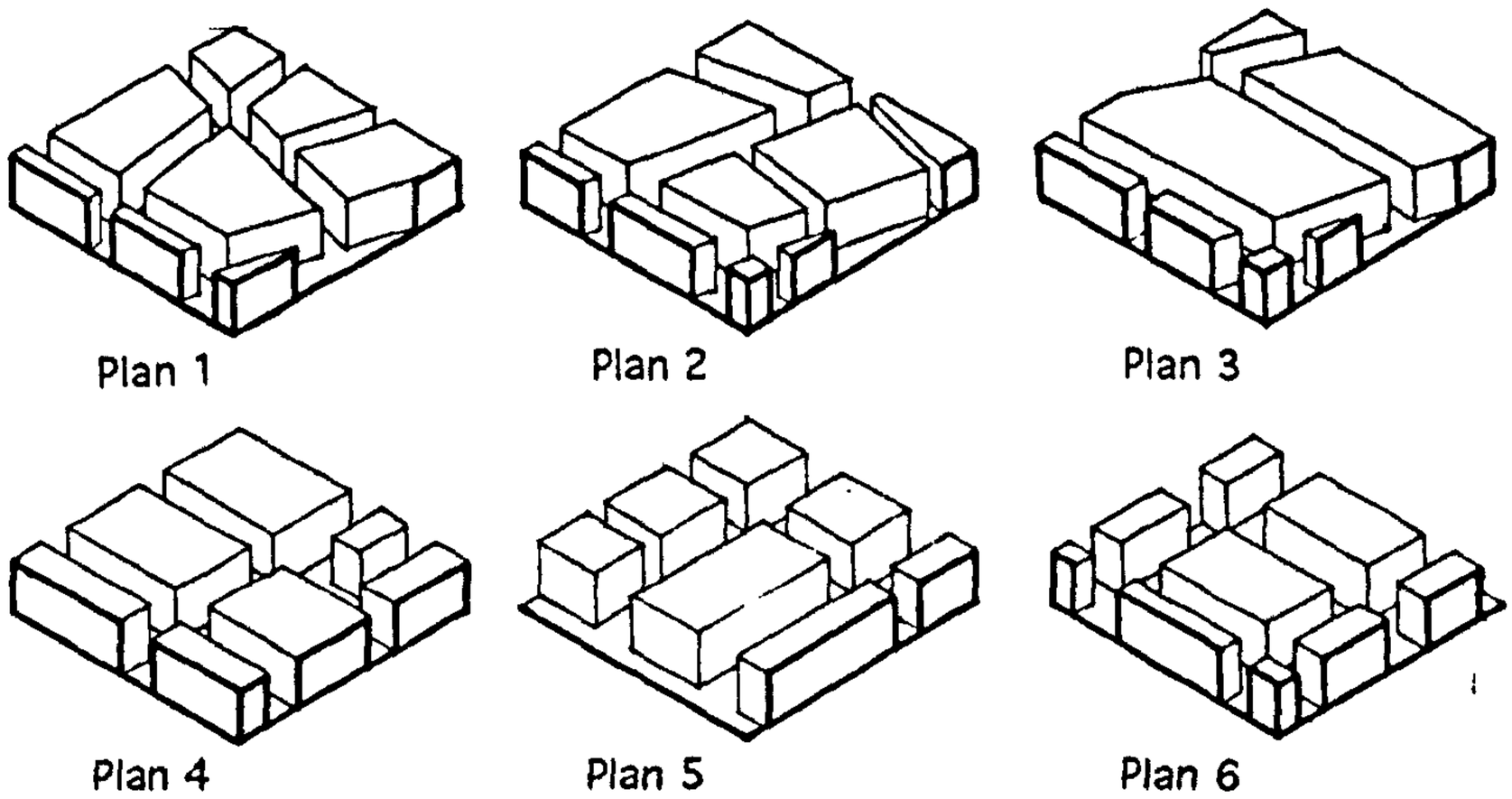


Fig.71-Perspective of "the typical hectare".

As is shown in the perspectives of the approved plan, the total area of buildings per "typical hectare" (see Fig.72) physically occupied half a "*hectare*". In plans one to four the total area occupied by the buildings was in excess of a half hectare and in plan six it was less.

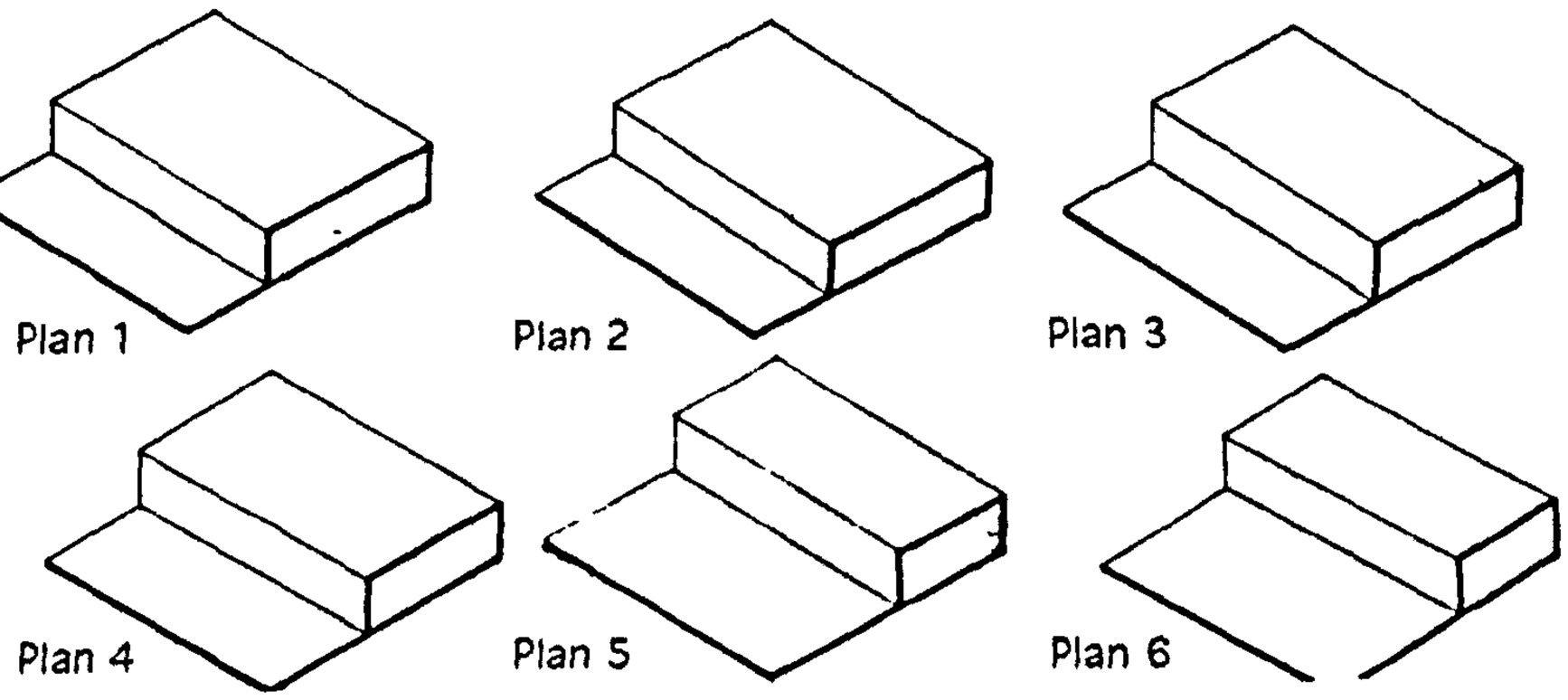


Fig.72-Area occupied by buildings

In the approved plan the length of the façades, as is shown in figure 73, is between the shortest (plan number three) and the longest (plan number two), which means more shops façades to the streets in relation to the interior spaces.

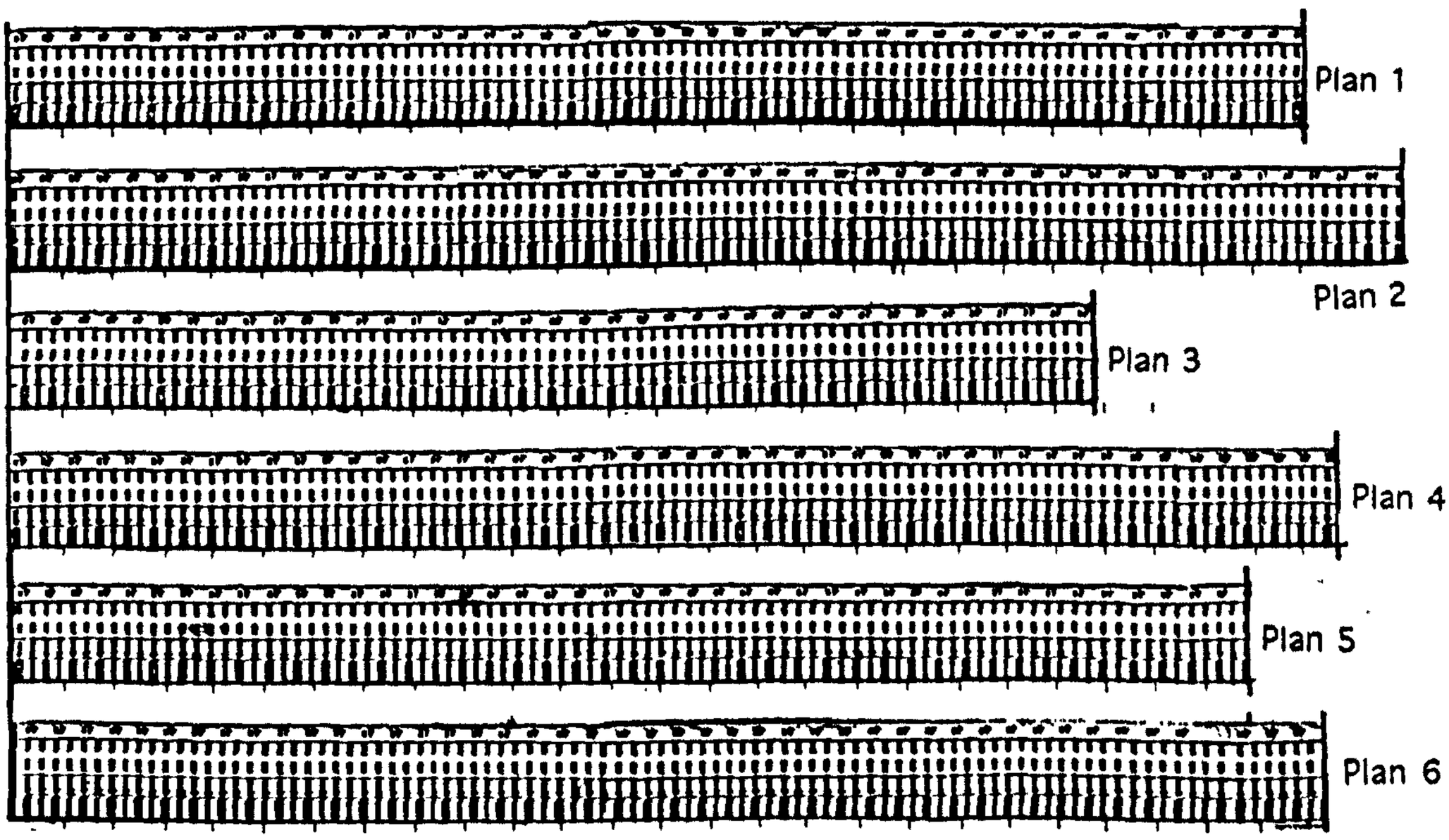


Fig.73-Overall length of façades.

I.8.3. The approved plan - Its innovative aspects and limitations.

The new approved plan, for which the public works were started on 15th May 1756 by the builder Manoel Martins(31), incorporated not only new urban concepts, but also innovations in terms of functional and preventive measures, related to possible calamities.

For example separate thoroughfares for pedestrians and vehicles were established with exact widths for streets and pavements (2, 20). However the pavements were the target of serious criticism because they were unpleasant, badly paved, and uneven, thus dangerous at night (2).

Manuel da Maia suggested a street width of 60 *palmos*, divided into three parts, in imitation of some in London. The central carriageway 40 *palmos* wide was for carts and people on horseback and was to be paved with small stones. The two side ones 10 *palmos* wide were for pedestrians and sedan chairs, and were separated from the carriageway by stone bollards, *frades*, which aimed to protect pedestrians from the vehicle´s wheels, (see Fig.74).

To enable the water to flow down from the upper areas, and allow for the cleaning of the pipes that come from the buildings, the *cloaca* or Royal pipe was created (see Fig.74)(2, 20).

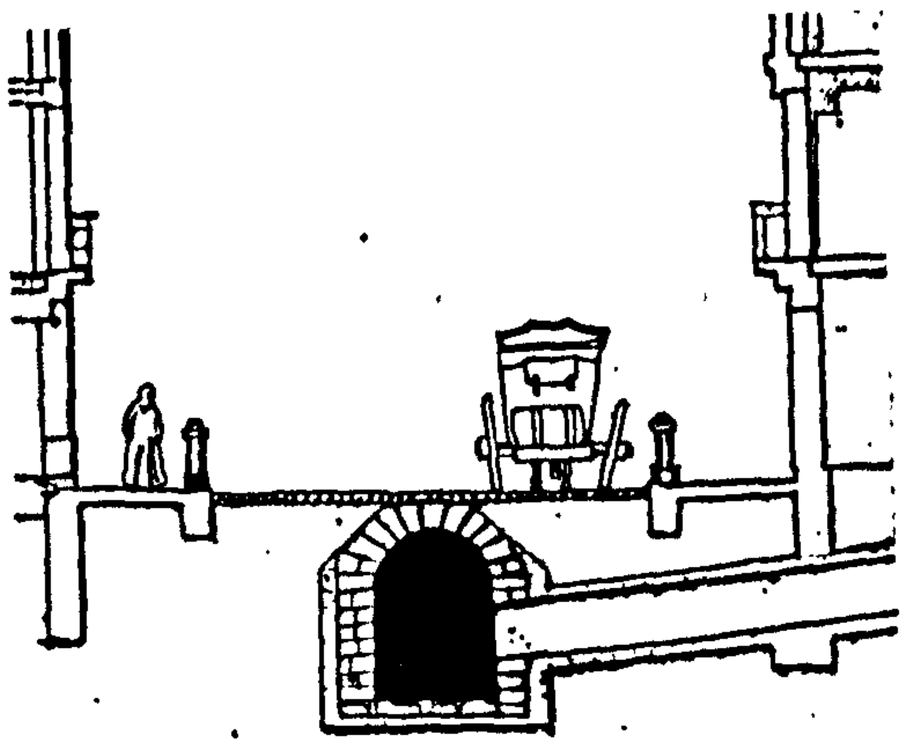


Fig.74-Cross section of a street and the system of sewerage.

Fig.75-The rigorous alignment of the buildings.

According to Architect Carlos Mardel, the rigorous alignment of the buildings as well as the observance of the planned widths, were highly beneficial, (see Fig.75). They avoided possible injuries caused by structural damage in case of an earthquake and made fire fighting easier. They also provided better lighting and air circulation.

The side streets, which crossed the main ones and were necessary for service purposes and to provide better ventilation and lighting for the city, had to be 40 *palmos* wide; 20 for the carriageway and 10 to each footpath. On these streets French windows were not permitted and the ground floor had to be left for the construction of stables, (see Fig.76).

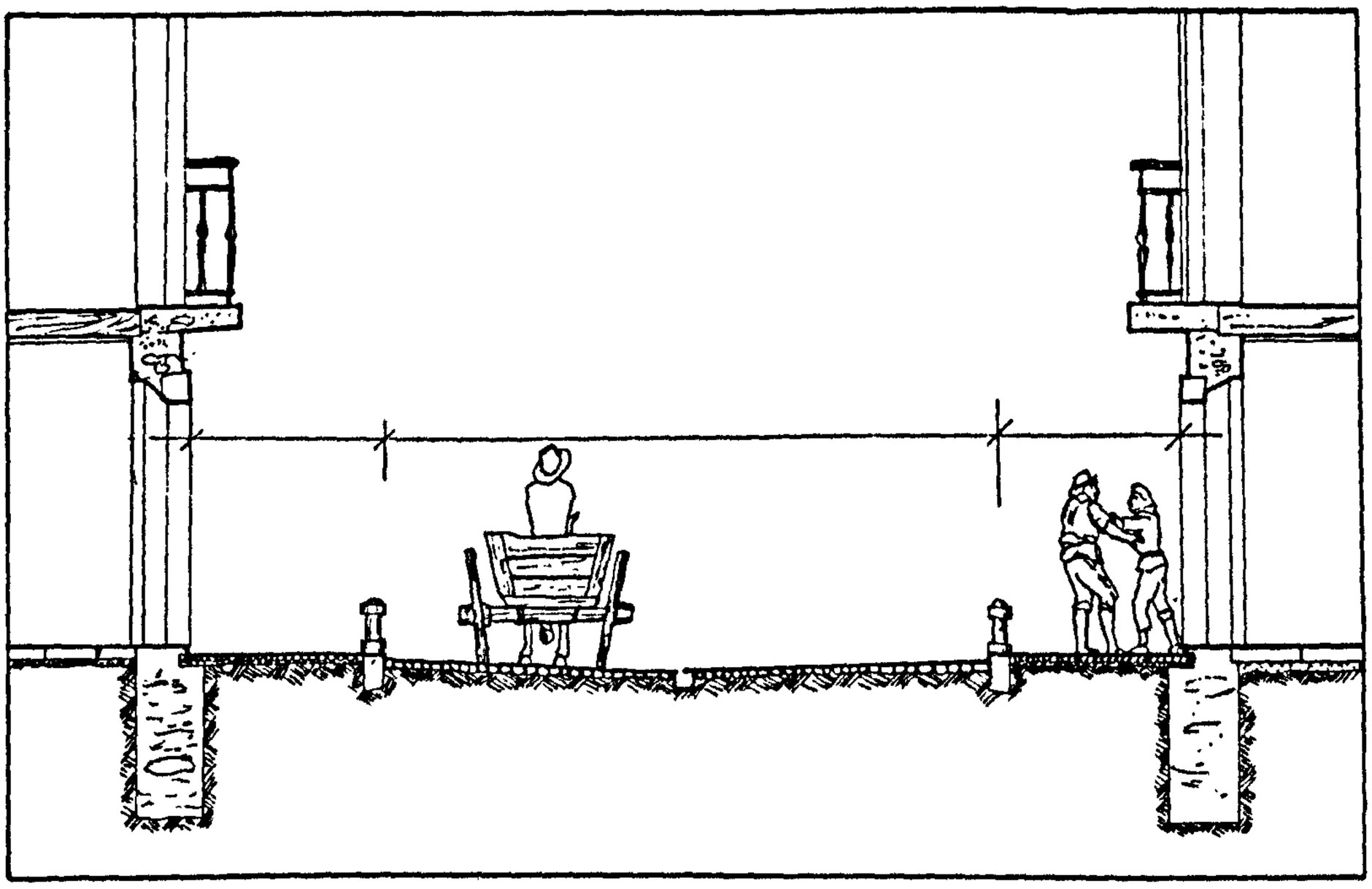


Fig. 76-The width of a side street.

In the Terreiro do Paço, for the new plan, Manuel da Maia suggested building public buildings in a more aristocratic style than had previously existed, with pediments and arcades providing protection from inclement weather and with two storeys above the arcade in which windows could be formed (2, 20).

The height of the rentable buildings had to conform with that of the buildings of the Terreiro do Paço, but the number of floors allocated to each building could be varied. Only shops had to be of a standard height of 16 palms, and the remaining height could be divided between the upper floors as desired (see Fig.77) (31).

The introduction of mezzanines was not difficult to achieve in buildings constructed on sloping streets (see Fig.78).

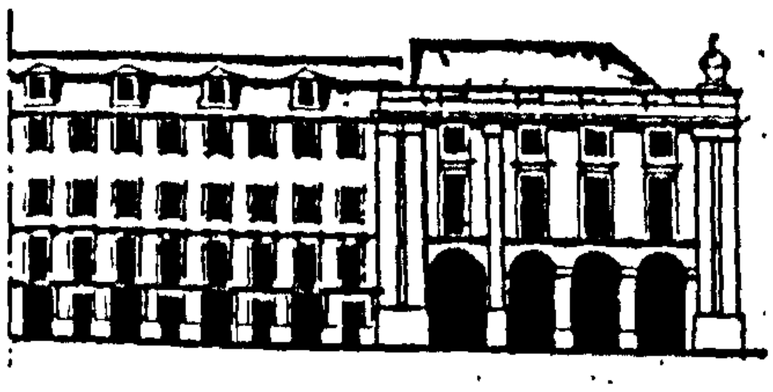


Fig. 77-The height of the buildings.

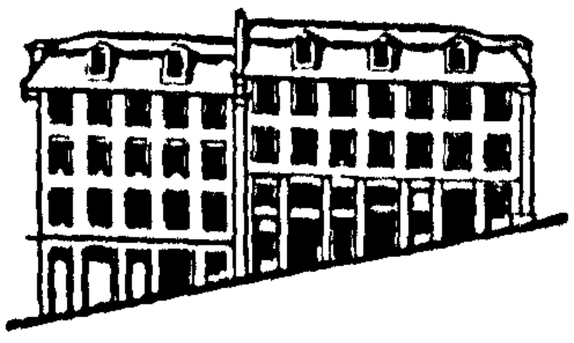


Fig. 78-The buildings on sloping streets.

The first floor would have French windows with balconies. The windows of the second and higher floors were to have fairly low cills and were to diminish in height from one floor to the next one above. When the buildings had stables the access to these was to be from side streets (3). Any upward extension of the buildings including timber framed extension, was prohibited (31). The attic floors were intended to be used for domestic storage, but it was required that a lath-and-plaster finish should be applied to all ceilings and vertical framing. Dormer windows were proposed for the attics, both to ventilate the roof timbers and to contribute to the appearance of the front elevation, (see Fig.79 and 80) (31).

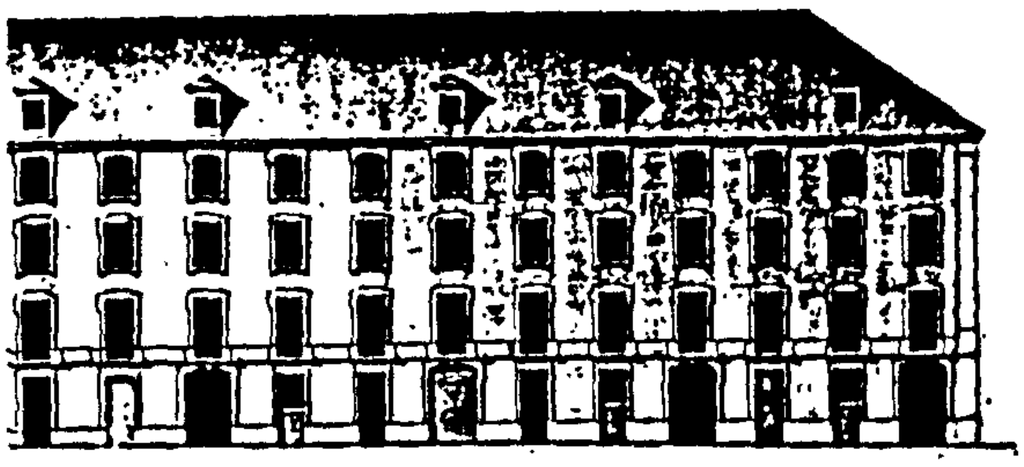


Fig.79-Dormer windows on front elevation.

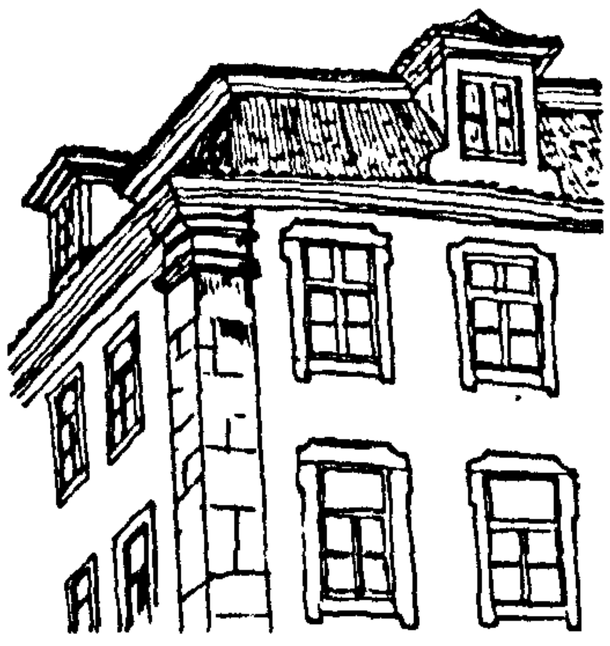


Fig.80-Perspective of dormer windows in main streets.

Another innovation was introduced due to the fact that with all buildings being of the same height, fire could spread easily between them unless precautions were taken. Therefore walls were extended above the roofs. These walls were party walls and built in a way almost invisible from the street (31).

Next to the church of each parish, there was a water pump together with a large number of leather buckets for fighting fires(31) (see Fig.81).

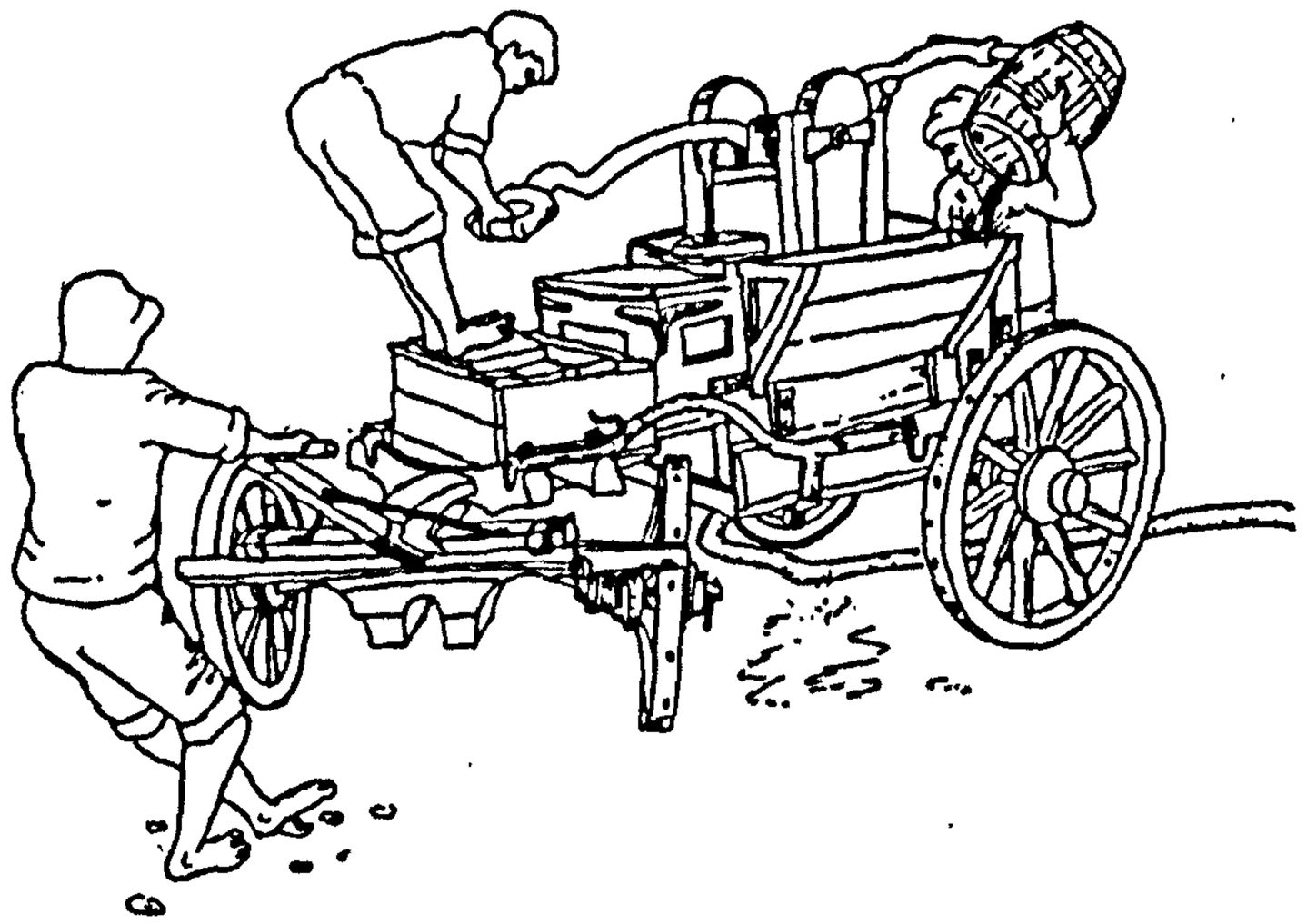


Fig.81-Pombal fire fighting vehicle.

The supply of water to these low parts of the city was regarded as essential. The ideal objective was the existence of a fountain in each street and a water tap in each house (31). If this ideal objective could not be entirely achieved, it could at least be in part, by for example, limited extension of the piping system from the old aqueduct (2, 20).

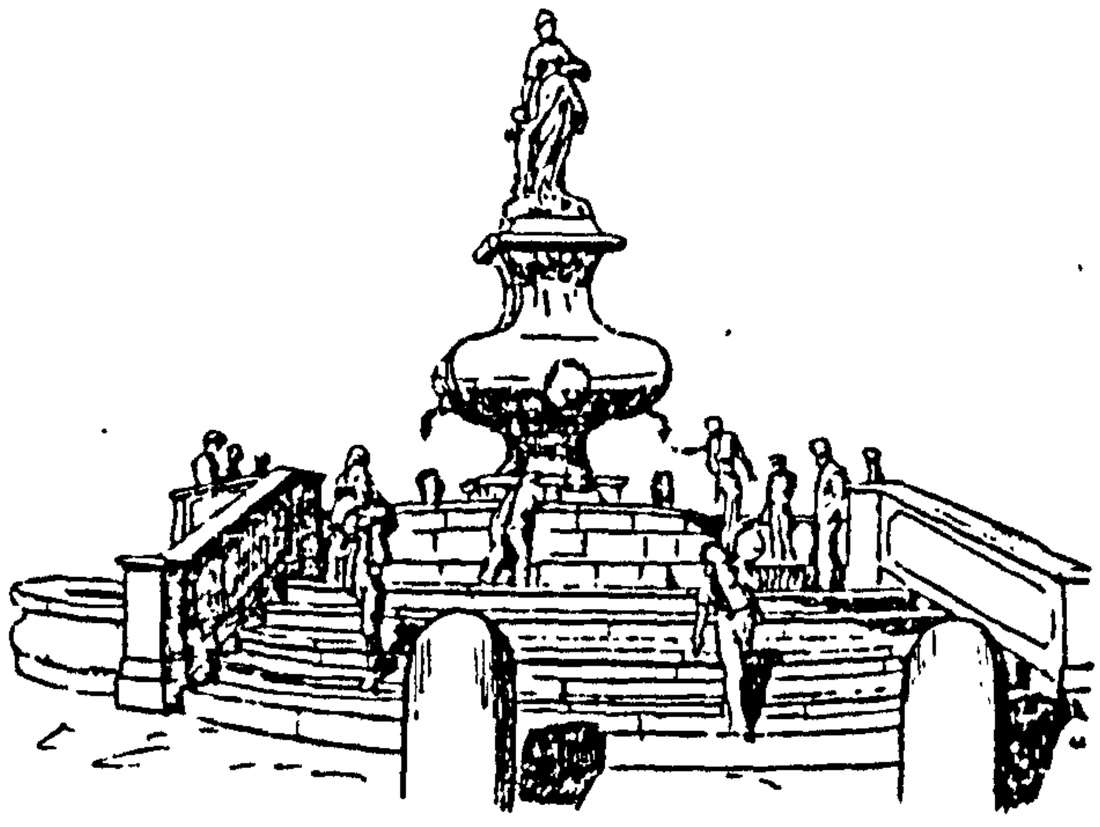


Fig. 82-A fountain

Fig. 83-The transport of water from fountains to the buildings.

Provision was made for a piping system to feed water to the fountains (see Fig.82), to supply the inhabitants of the new buildings (see Fig.83) and for fire fighting purposes. This was to be achieved with a number of fountains. For example, the Terreiro do Paço fountain (supplied with water coming from the Cruzes da Sé), the fountain in Rossio Square (received water from the Bairro Alto), the fountain in the Hospital of Todos os Santos (fed by a conduit coming from Desterro), and the Vitoria Square fountain (supplied through Bairro Alto) (2).

At the time when the rebuilding proposals were being drawn up, the usual method of sewage disposal in most areas consisted of transporting, in large horse drawn carts to appropriate locations outside the town, all the solid and liquid detritus thrown out of the windows (2).

Three suggestions were proposed by Manuel da Maia to improve this situation.

The first, which had already been used in some countries, consisted of the construction of underground sewers running down the middle of the main streets with the necessary capacity to receive both solid and liquid waste from the buildings (2).

From these sewers a subsystem of underground sewers would be provided to drain the main sewer (see Fig.84). The city already had sewers of this type which served convents and manor-houses, which were connected to the Royal system of sewage. However much of the system was eroded and the proposed new street layout implied its replacement (2).

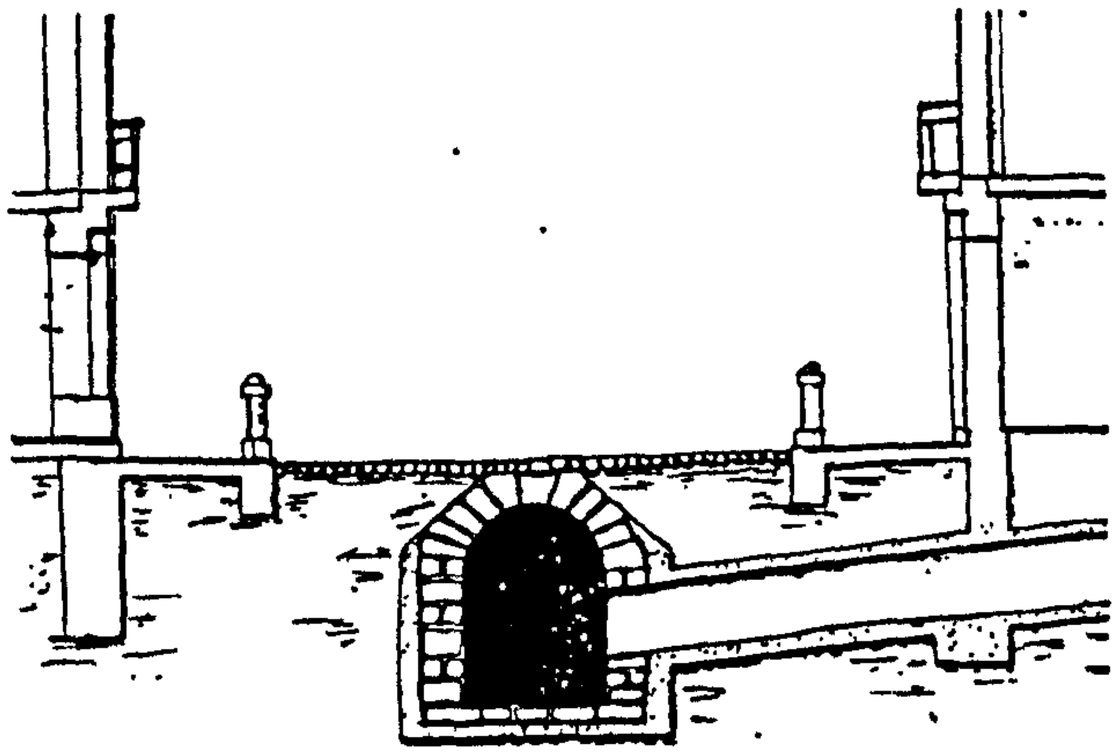


Fig.84-The system of sewerage, *cloaca*.

The second method, consisted of collecting, early in the morning from the streets, only the solid waste and other debris that might block the street, leaving the liquid waste which would rapidly dissipate (2).

The third method, consisted of leaving free space between the backs of all the rows of buildings comprising narrow "streets" of five or six *palmos* (see Fig.85), which would be called *alfugeres* (open sewer). No doors would open on to them, and waste could be thrown into them from the windows of upper floors. Once a year, in Autumn, this waste could be removed and transported by means of large, horse-drawn, carts to appropriate locations. This solution had the disadvantage to the tenants of generating unpleasant odours. This could be reduced by glazing the rear windows of the buildings (2, 32,33).

The use of underground sewers and establishing *alfugeres* seemed to Manuel da Maia to be the best solution. The sewers were therefore built beneath the middle of the street and were 10 *palmos* wide by 14 high. Unfortunately, due to technical flaws such as abrasive walls, and square sections, sedimentation and build up of solid waste occurred which prevented the inflow of the river waters into the sewers' interior. Thus the sewers were not effectively self-cleansing and the Municipal authority did not provide an effective and regular cleansing service. Also the rubbish collection system from alfugeres proved to be deficient and people had to remove their own waste (Fig.86).

Manuel da Maia seemed very concerned about the possibility of these inner yards harbouring infectious diseases. Every Autumn this rubbish was to be collected, because in winter, the higher density of the air due to the cold weather could cause the stench to be unbearable (33).

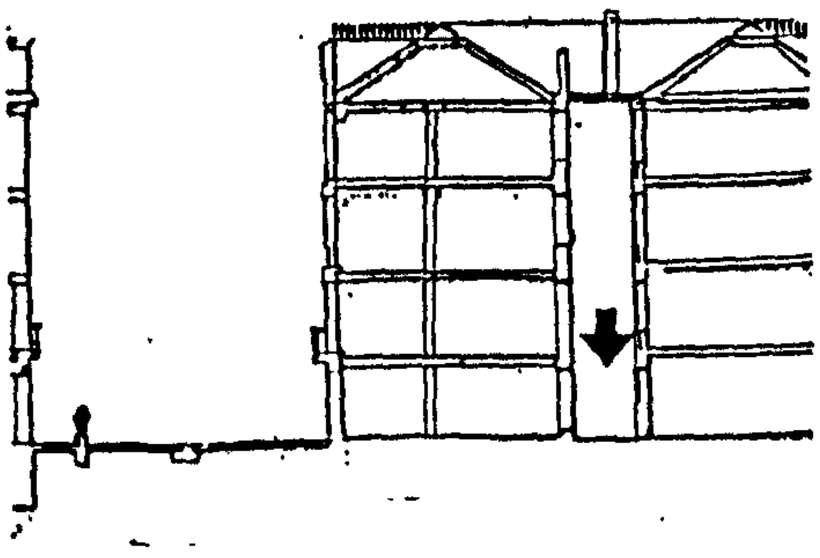


Fig.85-The alfugere

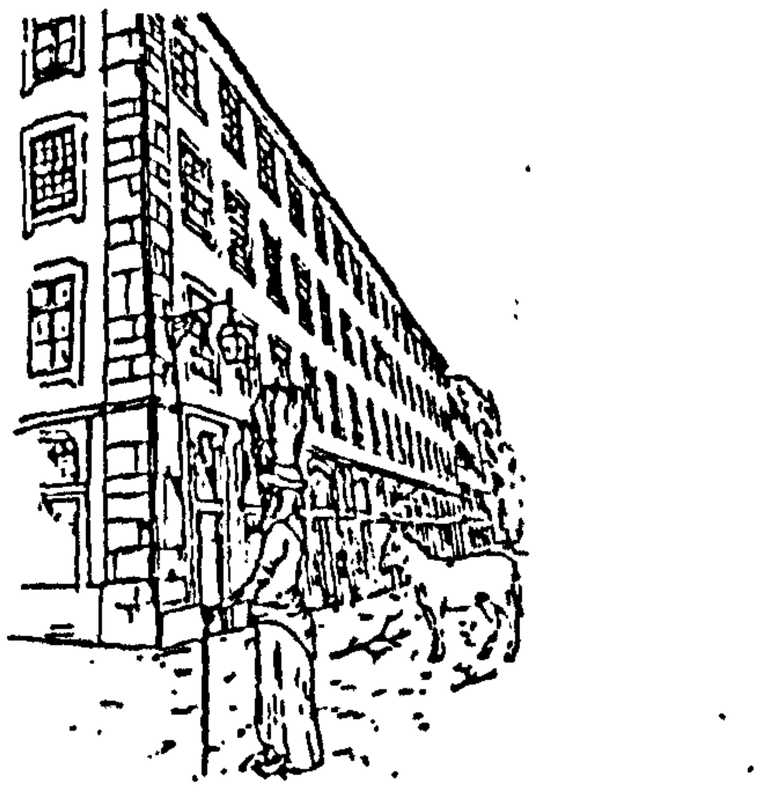


Fig.86-A woman transporting detritus

But the system did not operate and the stench caused by the rubbish attracted many dogs. Therefore the environment left much to be desired and was compounded by the unevenness of the pebbles that covered the streets. Also during the night the illumination of the streets was inadequate as it left many shadows where criminals could lurk. In order to be able to defend themselves from attacks by criminals, people usually walked accompanied by servants carrying lanterns and torches (33).

Street lights consisted of lanterns of olive oil or even physic-nut which was much cheaper (see Fig.87). When there was moonlight, or when funds ran out, public lights were not lit. In order to help pedestrians at night, a stone plinth ran along the façade of the buildings to guide them (see Fig.88)(33).

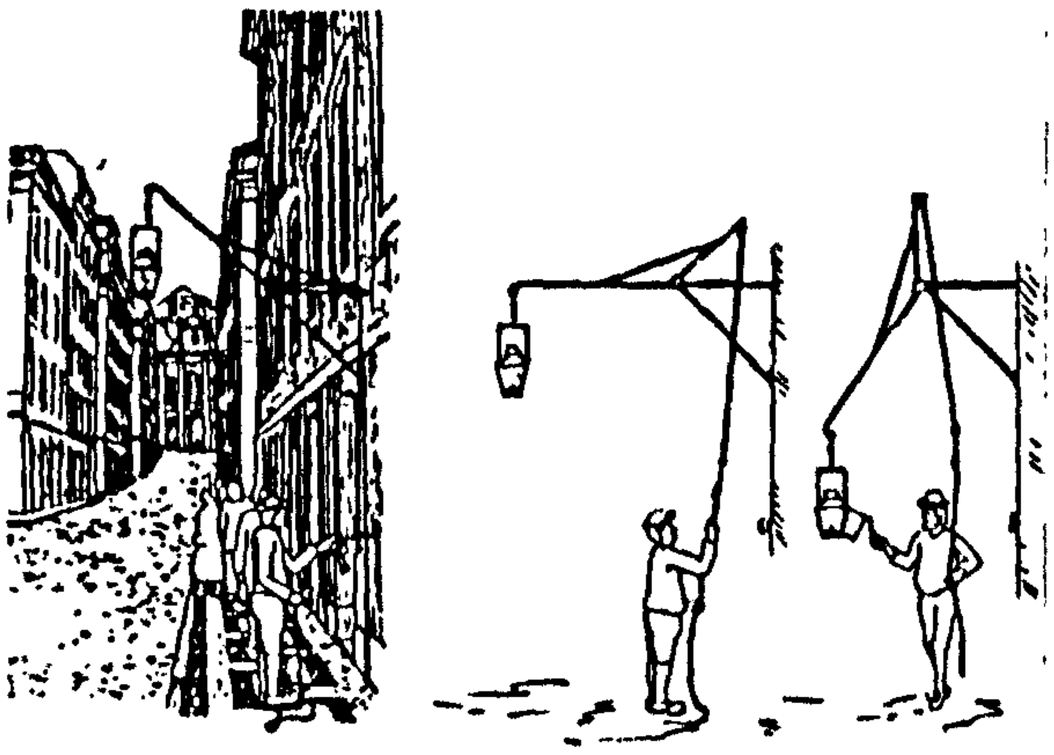


Fig.87-The public illumination

Fig.88-The buildings with the frieze.

I.9. The precursors of the Pombaline period.

The Pombaline rentable buildings possess very specific characteristics especially as regards their simplicity, and their respect to austerity on the economic use of materials and construction processes. This is due to the special economic and political circumstances which prevailed at that time. These rentable buildings are clearly distinct in style, in architectural terms, from those adopted both before and after the period of the Marquis of Pombal´s ministry.

In Portugal, before the Pombaline phenomenon, there were two periods of architectural exuberance, corresponding to two periods of economic prosperity. These were the Manueline period, when prosperity arose through trade with India (late Portuguese Gothic, 1500-1550), and the Joanino period, associated with the discovery of gold and diamonds in Brazil (Portuguese Baroque, 1700-1750). In between these periods there was a period of great austerity when the architecture was characterized by a return to simplicity and elegant proportions, the "Chã Architecture", (Fig.89)(34).

Prosperity in the Manueline period, was achieved through trade with the Orient. It created an architecture characterized by the overworking of excessively decorated stone surfaces. The period of prosperity ended with the decline of that trade due to competition from other European powers and over spending on the defence of faraway possessions. This decline was further accelerated by the defeat of the Portuguese King Dom Sebasteão at Alcácer Quibir (1570).

Having lost its independence to Spain in 1580, the country subsequently experienced a period of penury and pain. During this period of economic decline the architecture was marked by sobriety, by emphasis on volume and proportion and an end to the practice of carving. This period termed the period of "Chã" architecture was conditioned by old traditions. It represented a return to the frugal principles of vernacular architecture rather than being conditioned by the direct influence of what was in fashion, and was characterized by clarity, order, repetition, proportion and simplicity. As in the later Pombaline period, "Chã" architecture, was also started by military architects, due to the circumstances of the time, (Fig. 91, 92 and 93) (34, 35).

European Architecture

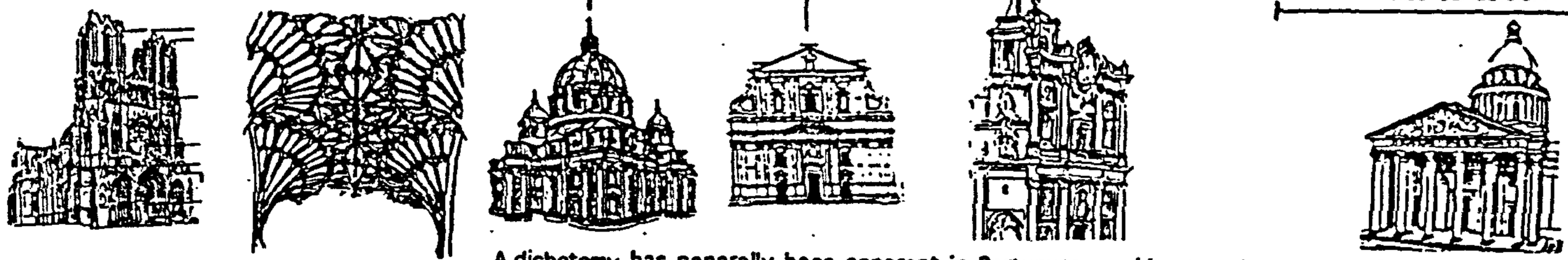
1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1800 1850

1250 GOTHIC LATER GOTHIC 1500

1420 RENAISSANCE MANNERISM 1600

BAROQUE AND ROCOCO 1760

NEO-CLASSICISM



A dichotomy has generally been apparent in Portuguese architecture between an instinct for simple elegance in the form of buildings and love of sumptuous embellishment

Economic situation of Portugal

1550 1650 1717 1770 1804 1830

Variation of economical situation

Golden Era of discoveries, Portugal controlled a vast empire.

D. Sebastião was defeated by the Morrocon forces in Alcácer-Kabir.
Filipe II of Spain invaded the country and became King of Portugal.

Portuguese rebelled and proclaimed the independence.
Development of the exploration of the Brazilian gold mines.

Commercial crisis. 1755 Earthquake

Consolidation of the economy.

French army invaded Portugal.
The royal Family took refuge in Brazil.

Portuguese Architecture

1500 1530 1580 1700 1750 1780 1800 1830

Variation of austerity in architecture

Portuguese later Gothic (Manueline) -Exuberant inspiration from the voyages of the discoveries

Renaissance

Plain "Chã"

Roman baroque monumental Portuguese Baroque Joanino

Ruthlessly efficient

Highly Flamboyant Rococo

Fig.89-Portuguese Architecture and the economic situation

In the architecture of this period and especially toward its end it is possible to find some compositions that may have influenced the architecture of the Pombaline rentable building.

However regardless of these links it is clear that the Pombaline building is the result not of simple copies of buildings that already existed but of a new concept in building, a building adapted to rational mass production, carefully designed to produce an economic, hygienic and safe building founded on the simple, traditional way of building, without neglecting the clarity and order of classical antiquity (36).

The composition of the façade, the number of floors, the shape of the stones around the spaces and the use of balcony windows on the first floor of the buildings, had its origins in the composition of the Ludovice Palace (1740) situated in the "Upper Quarter" (Bairro Alto), (Fig.90). However the elements that formed the façades were simplified, with the aim of standardizing the production of components (2).

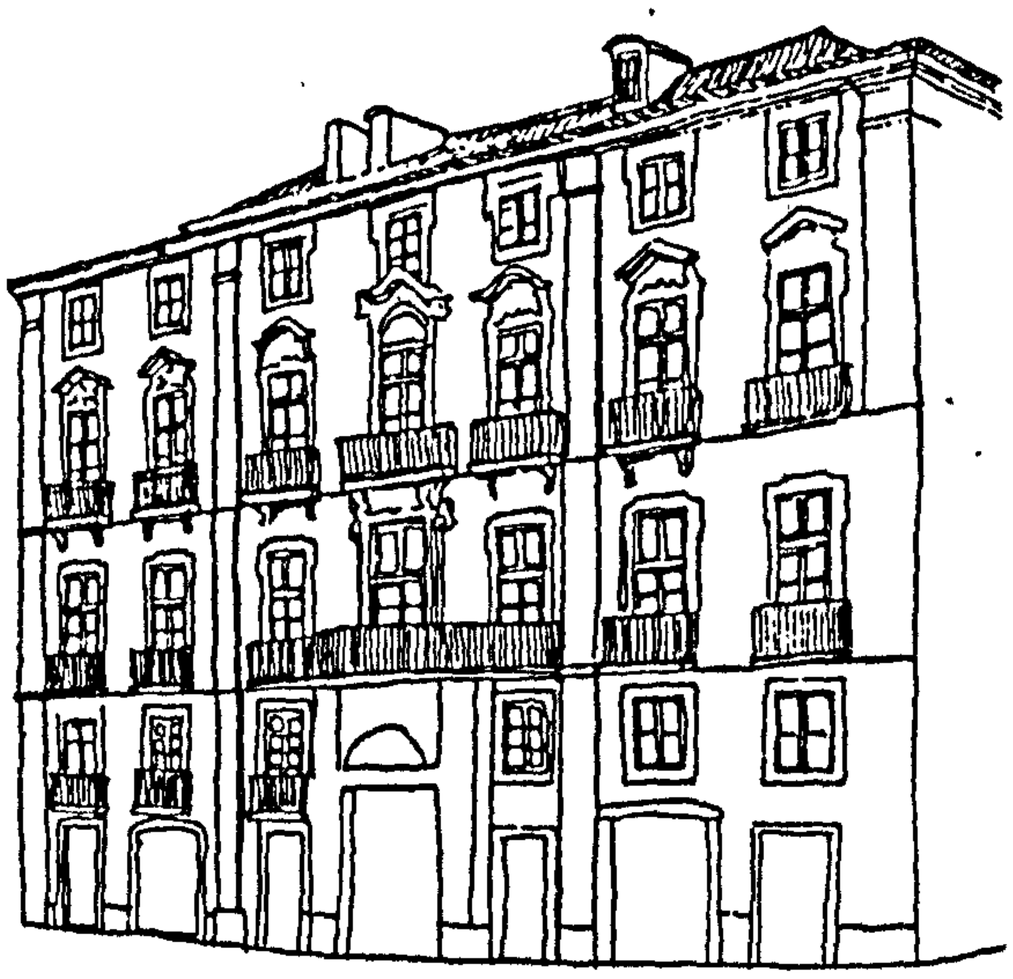


Fig.90-Ludovice Palace (Lisbon)

The pilasters finishing off the blocks, the solidity of the ground floor stone walls, the stones forming the cornerstones, the connecting elements, the arches and solid brick vaults and the staircases with the first two flights in carved stone, seem to originate in the large urban mansions, like the Galveas Palace (1650-70) which were the homes of the nobility , (Fig.91).

Fig.91-Galveas Palace (Lisbon).

The straight frontons (heads) of the balcony windows of the Pombaline buildings on Arsenal Street and Rossio, had occurred much earlier, as in the case of the Palace of the Duques de Aveiro in Azeitão (before 1619), (Fig.92). and also in the upper floor windows of the dormitory in the Alcobaça Monastery (1716), (Fig.93).

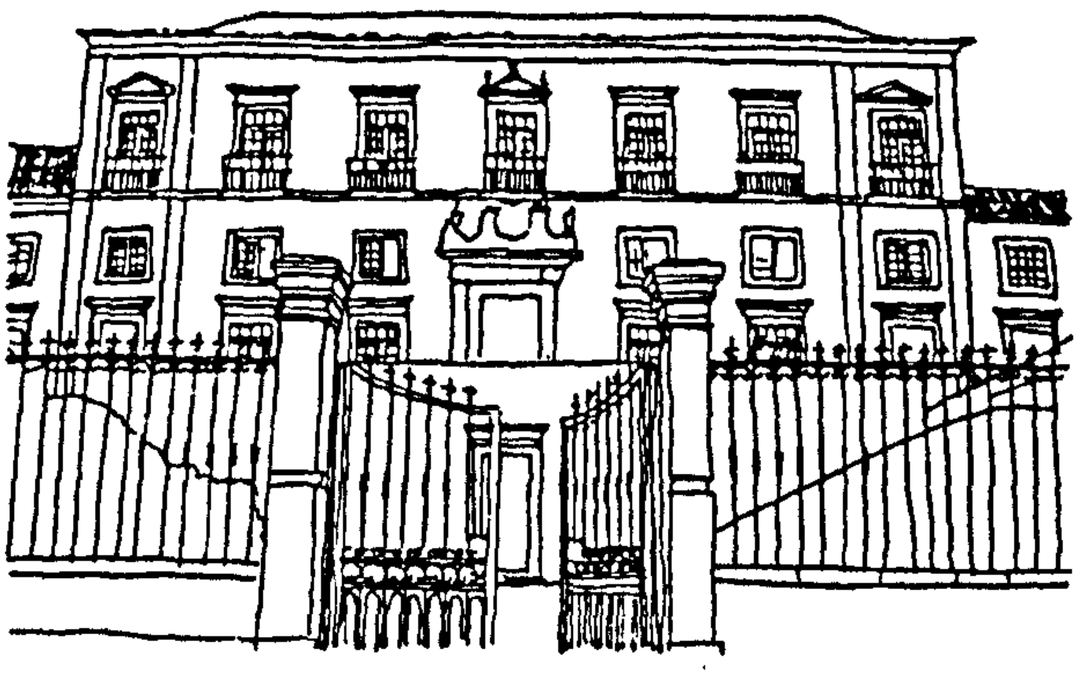


Fig.92- Palace of the Duques de Aveiro

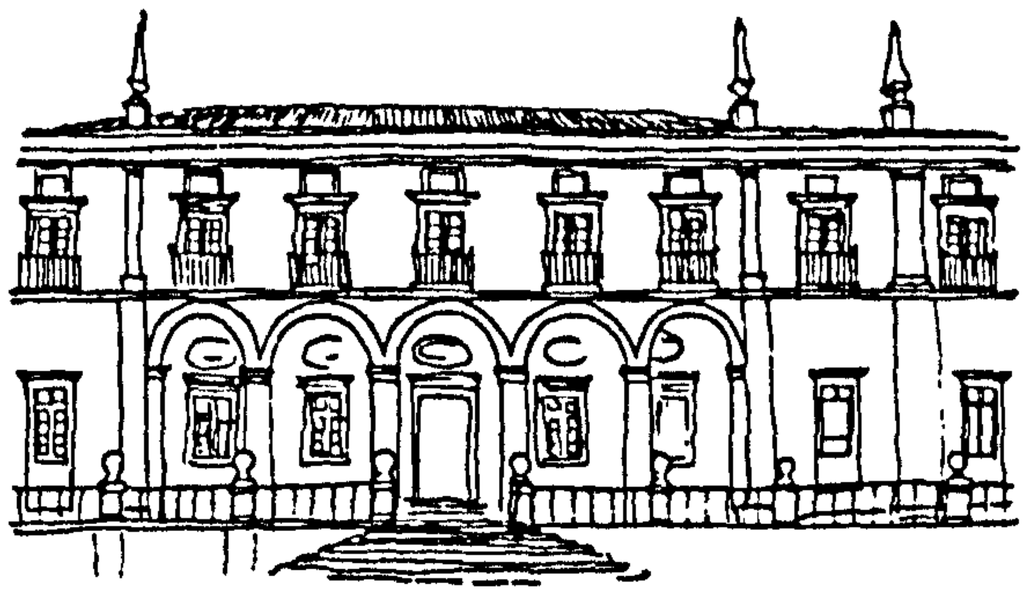


Fig.93-Dormitory of the Alcobaça Monastery

There are also other aspects such as the repetitive nature of the Pombaline buildings which have equivalents in previous structures. For example around 1600 continuous inflation and a deep depression obliged the religious orders to invest in property, and in particular to construct convents with long dormitories.

The rigorous modulation and continuous repetition of the façades of the Pombaline buildings, (spaces on the façade were perfectly lined up both vertically and horizontally), appear to be closely related to the impressive modulation and simplicity of the Jesuit Architecture. Due to constant expansion in new territories, especially in Brazil, the Jesuits had, like the Marquis de Pombal, to build quickly and economically(37).

Their buildings had a sober character with rigid, disciplined lines(38)(see Fig.94). At the beginning of the eighteenth century due to the discovery of gold mines in Brazil, the buildings became sumptuous, dominated by excessive decoration of the interiors with carved wood (the Joanino period). But the austerity and repetition were maintained in the dormitories of religious buildings, like in the Convent of Santa Clara a Nova de Coimbra (1713), where the dormitories extend to more than 400m, (Fig.95).

Fig.94-S. Roque Church, (1582-1627) Lisbon

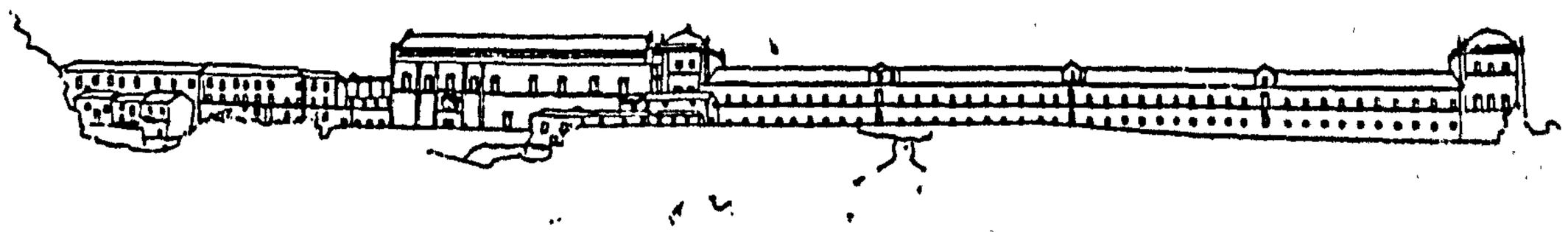


Fig.95-Elevation of Santa Clara a Nova (Coimbra).

In addition the professionals in charge of the reconstruction of the Pombaline quarter were mainly military personnel or people with previous military experience.

Due to their training and the fact that the leading mentors of the "Casa do Risco" held military posts(2), it is highly likely that the principles of rigid discipline which are apparent in the reconstruction plans were a practical reflection of the disciplined education at the Military Academy(39).

The construction system was simplified. and standardized in order that pre-fabricated components could be used. The "cage", structure, that had already existed before the earthquake, was studied, tested and improved to allow buildings with three levels to be built safely on unstable land (40).

The interior typologies started with a typology that existed in old areas of Lisbon, and were immediately developed in order to adapt to the rigid economic principles and the imposed street elevations of the buildings.

I.10. European and Colonial influence on the design of Pombaline Quarter

Whilst Portuguese buildings seem to provide the models for the design of the Pombaline elevations, the urban planning is more likely to have been influenced by developments abroad. London and Turin are specifically mentioned by da Maia in his dissertations (2) and he would also no doubt have been aware of recent developments in Paris and Spanish colonial cities in América.

Paris is the site of some early, large scale residential developments with repetitive façades. In the Place Dauphine (1606, Fig.96) the plans of the houses are also repetitive, but later in the Place Vendome (41), in 1685 the facades were built without buildings behind them. It was planned to build a series of public buildings behind them, but before this could be done the plan was changed and the facades were demolished. Between 1699 and 1708 they were again built and the plots behind sold to individual buyers.

Fig.96-Paris, Place Vendome and Place Dauphine.

It is not recorded whether the individual buyers were allowed to build to their own individual layouts, but the principle of a unified, repetitive, common facade fronting a number of individually owned and constructed buildings had been established.

The rebuilding of London [42, 43] after the Great Fire of 1666 at first sight seems to bear little relation to the Pombaline quarter (see Figure 97). However the plan by Captain Valentine Knight, which was not executed, includes rules governing the sizes of components in the facades, the height of buildings and widths of streets, and this may well have provided the precedent for a similar regulative framework controlling the Pombaline area.

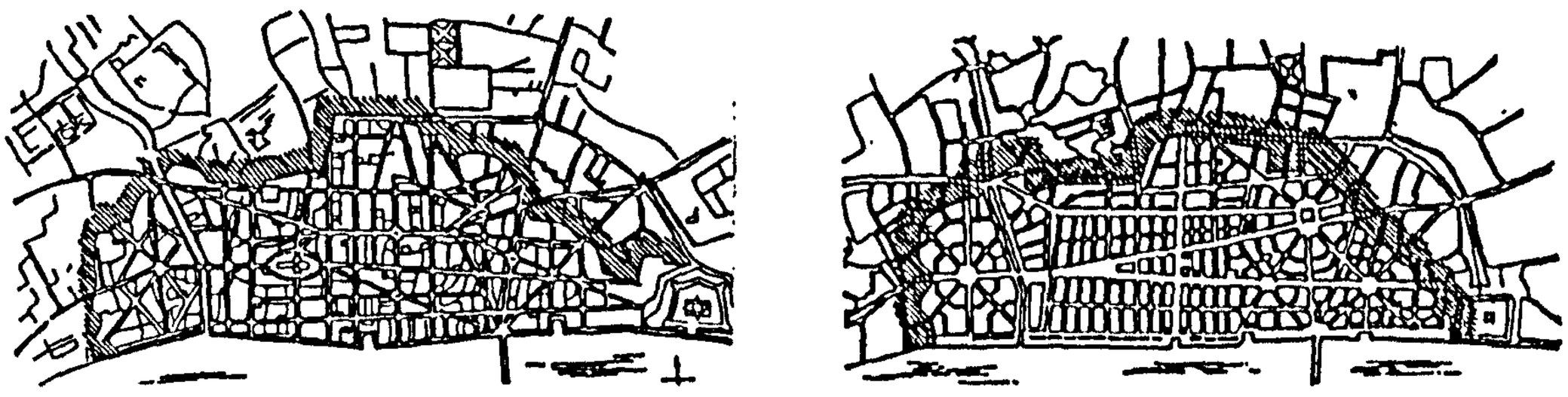


Fig.97-London, plans for reconstruction after the great fire of 1666, first plan proposed by Evelyn and by Wren.

Orthogonal plans [41, 44] are found in a number of Spanish colonial cities in America, such as Candelaria (1627, Fig.98), Mexico City (1688), Quito (1734) and Caracas (1750), in all of which developments the existing urban fabric was destroyed to make way for the imposition of the new plan [45].

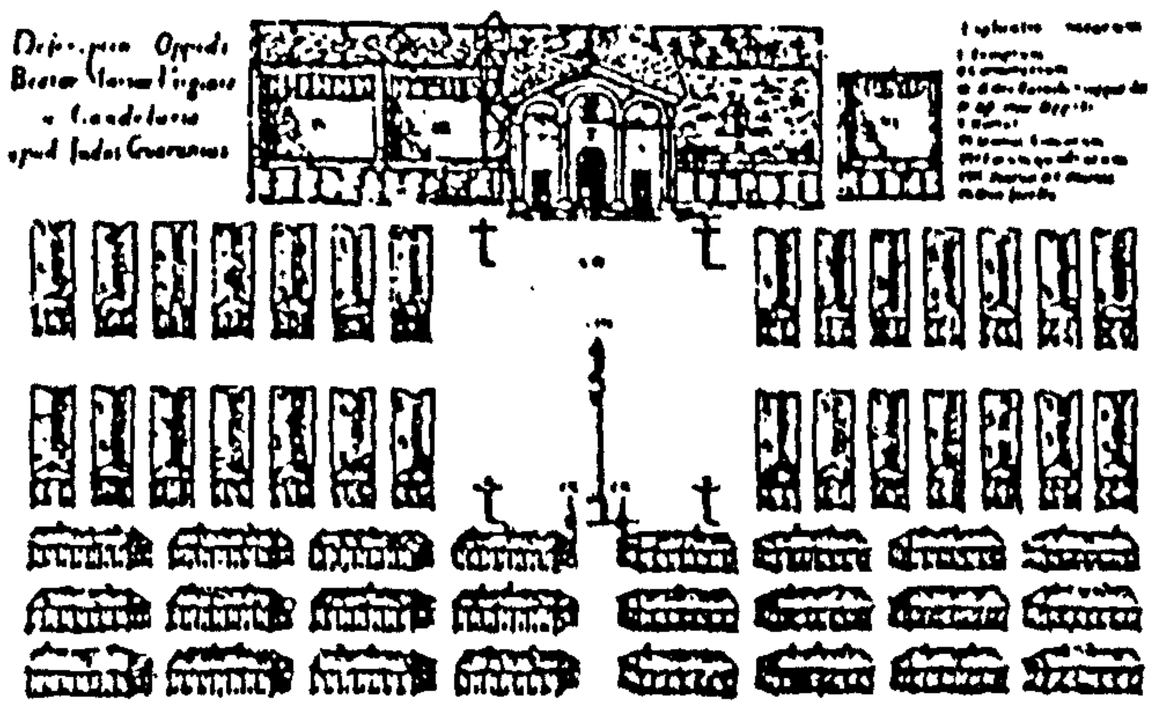


Fig.98-Colonial city, Candelária

Turin was possibly the most influential development in relation to the Pombaline rebuilding. The original city was enlarged in 1714 with a series of orthogonal streets and squares (see Fig.99). The buildings were similar to those of the Pombaline quarter in being a mixture of commercial properties at ground level and residential floors above. The proportions of the elevations are similar in the two developments, and Turin also has narrow access courts in the interior of the blocks, similar to the *alfugeres* of the Pombaline quarter.

Fig.99-Turin, enlargement in eighteenth century.

Possible models for the construction system used in the Pombaline buildings, particularly the *gaiola* or cage, are considered in Chapter IV.

I.11. The originators (creators) of the Pombaline rentable building.

To coordinate the reconstruction of the city after the earthquake the Marquis of Pombal set up a group under the name of "*Casa do Risco das Reais Obras Públicas*", (The Planning House for Royal Public Works). The group consisted of competent and determined Professionals who worked with industry and commitment,(2) each one of them contributing significantly to the creation of the rentable building. Among them were several deserving special mention. These were:

Manuel da Maia (1672-1768), *Engenheiro-Môr do Reino*, (Royal Engineer-in-Chief) was the one who set out the principles of the reconstruction. As we have seen, he was the author of written proposals for the reconstruction of the city in which the basic characteristics that the buildings should possess in terms of comfort, safety and hygiene were described along with the first drawings of them.(2, 40)

Eugénio dos Santos (1711-1760), *Arquitecto do Senado*, (Senate Architect), a disciple of Manuel da Maia and the author of "*Aula da Fortificação*"(lesson in constructing military buildings), was the author of the approved plan. He dedicated himself totally to the reconstruction, working almost to the point of exhaustion. He provided the practical interpretation of the principles established by Manuel da Maia, both at the urban level and in the plan of the rentable buildings themselves and he was very aware of the need to create a modern city.(2, 36)

Carlos Mardel, *Arquitecto dos Palácios Reais e das Ordens Militares,* (architect to the Royal palaces and the military Orders), (see Fig.100) With Eugenio dos Santos, he was the co-author of the approved plan and took over the co-ordination of the works in 1760, after Eugénio dos Santos´ death. He was responsible for the alterations made to the plan, as well as being the architect of the rentable buildings in the Rossio, characterized by their French mansard roofs and the alternating pattern of door/window at first floor level,(2)(see Fig.101).

Fig.100-Carlos Mardel

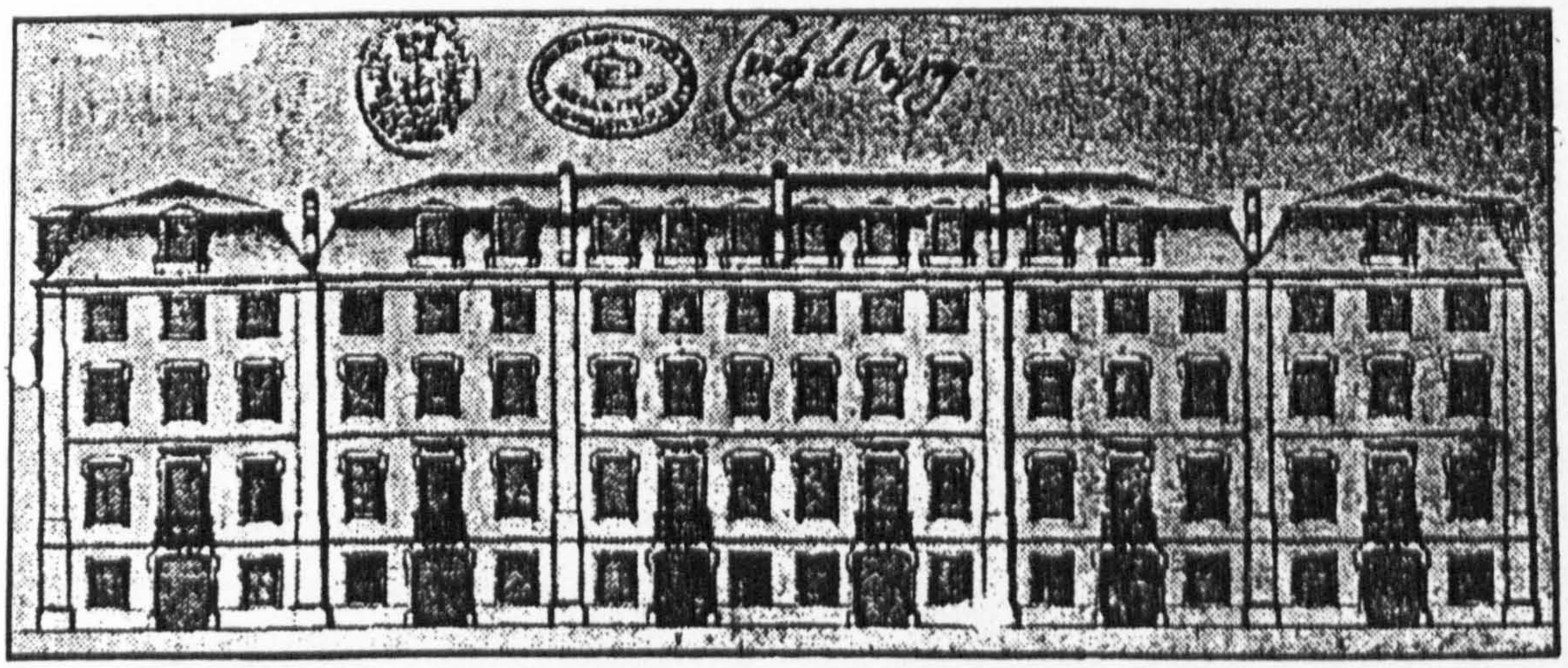


Fig.101- Rossio Square, South elevation.

Miguel Ângelo Blasco, a General in the infantry and an Engineer, succeeded Manuel da Maia as Engineer in chief, having previously been responsible for numerous rentable building projects(2, 4).

Reinaldo Manuel also a military engineer, and author of the plan of Vila Real de Santo António (new city). He made a modest contribution to the reconstruction of the Pombaline area(46).

I.12-The reconstruction of the city as the driving force behind Pombal´s economic policy.

The highly disciplined plan for the reconstruction appears to have represented a conscious effort to push forward the Pombaline social and economic reforms. Up to the time of the earthquake, Pombal had difficulty in imposing reforms. As minister he had tried to dynamise a rudimentary, ageing economy, redeemed from the evils of the inquisition, living from casual business, dependent on the scarce riches from Brazil, and on the importation of manufactured goods from Britain. The traditional nobility, powerful, but undynamic, used to every privilege, confusing their own interests with those of the state, fought against any move towards change. The Clergy, especially the friars, took advantage of their position, gained throughout the Inquisition and with religious fears they instigated and acquired vast sums for their own expenses (26).

The earthquake and the consequent flight of the king and other officials of the kingdom, left Pombal, as representative of the Crown, to order the first drastic measures in the name of the "public interest". With these measures successfully imposed and thus being immediately named Secretary of State for the Interior, he began his period of absolute rule. Faced by Pombal´s growing power in the state apparatus and by the complacency of the King, a few "clans" from the nobility decided to react, making an unsuccessful attempt against the King´s life. With the King´s support, the failed attempt led to opportunities to cruelly punish the nobility, reducing it to a bankrupt and persecuted class (2).

Shortly afterwards in 1759, taking advantage of the fact that measures had been taken in both France and Spain to persecute numerous religious orders, Pombal adopted the same attitude, even to the extent of expelling the Jesuits. A new organism took the place of the Inquisition, the Royal Censorial Table, directed by Pombal´s brother, which led to the creation of a fearsome police force (27).

In the earthquake disaster many British Merchants who had a privileged position in the market, suffered terrible casualties compelling some of them to leave. For Pombal it was an opportunity to replace them with his allies, the new merchant bourgeoisie, made up of many New Christians who were given special privileges like the creation of monopolies to exploit national and colonial wealth (28).

After the earthquake these initial measures gave Pombal the opportunity to establish absolute power. During the reconstruction process, many different mechanisms were created in order to strengthen the emerging new class, at the extense of the nobility and clergy. These included:

i) The attribution of political motives in the decision to rebuild the city *in situ* could be discounted, as the city was founded on unstable lands of alluvium, where the middle-class had their interests.

ii)The decision to rebuild the main body of the city *in situ* rather than to expand into the Belém area led to a further decision to rebuild the Royal Palace in Belém (2), which meant that the nobility were obliged to move out of the city and away from the commercial area.

iii)The prohibition of building outside the city walls on pain of demolition,(2) must have resulted in increased custom and land values for the middle-class businessmen and landowners within the city centre, which was the only permitted area for rentable buildings.

iv)In contrast to what normally occurred in a medieval urban structure where the planning was radial and the demand for land diminished with distance from the centre, the rebuilt central area of Lisbon, contains not a single focus to attract buyers, but three straight lines of equal importance, Ouro (gold), Prata (silver), and Augusta Streets, plus the Rossio and Comercio Squares, increasing the value of a large number of properties.

v)There were no significant variations in the architectural design of the buildings; the only form of hierarchy was in the width of the streets. There was no place for buildings, (e.g. great churches or palaces), which by their sumptuousness would upset the balance of property values. The few churches that were rebuilt, such as Conceição Velha, Conceição Nova and São Julião, were removed from the central area and relegated to the periphery and reduced in dimensions to an extension of the rentable buildings. The uniform, abstract style of the façades excluded palaces, and the nobility had to move out of the city limits to build their palaces.

vi)The strong aversion to the church, to the nobility and even to the royal family was epitomised in the changing of street names, for example:

Conceição (Immaculate Conception) to Retrozeiros (haberdashers´) street,

Bela Rainha (Pretty Queen) to Prata (Silver) street,

Nova Princesa (New Princess) to Fanqueiros (Drapers)street,

Principe (Prince) to 1º de Dezembro (1st December) street.

vii)The rules and standards adopted for the detailed layout, planning and design of the reconstruction of buildings in the new central area appear to have contained subtle mechanisms which favoured the amassing of private fortunes by individual members of the newly emerging commercial and professional classes. Documents (47) confirm that most of the owners of the area belong to this class (2, 47).

viii)In the allocation of space in the new buildings, small property owners were given priority over large ones increasing the size of properties of the growing class (2). Whenever there were problems in evaluating property and awarding compensation in the more important streets, this was undertaken by the Senate (31), which ensured that the interests of the new middle class were catered for.

ix)When a landowner gained in terms of space with the new plan, he could not compensate other landowners with property, only with cash (31). This also favoured the new middle class who tended to be wealthy in cash terms whereas the assets of the nobility were mainly held in land.

x) Members of the newly emerging middle class could build in the Pombaline area if they were able to find tenants (31). The Lisbon Senate itself took over some of the reconstruction, selling off buildings to the highest bidder to satisfy creditors, thus preventing the land being occupied by less well-off landowners.

xi)The proprietors were given five years in which to rebuild(31). Where they were unable to do so the property could be immediately acquired and disposed of by the Ministers, giving first option to buy to those with adjoining properties, that is to say those who were in tune with the policy of building fast.

xii)The interest to rebuild the city faster meant a rapid repayment of loans and also ensured that homeless people did not have to move to other parts of the city.

I.13. Summary

This chapter places in context the aim of this work which is to study the Pombaline rentable building, that emerged with the rebuilding of the city of Lisbon, after the 1755 earthquake. The first part, accompanied by a summary of the history of Portugal, gives an overview of the development of the city of Lisbon from its beginnings to the beginning of this century. The earthquake is described in the second part of this chapter which is followed by an outline of the social, enviromental and political climate which existed subsequent to and during the rebuilding of the centre of Lisbon after the 1755 earthquake. It has indicated how this climate was influenced by and also influenced the rebuilding programme. It includes a description of the first measures taken by the Marquis of Pombal to rebuild the city. It also outlines the proposals, plans and concerns presented by the Royal Engineer to rebuild a new city. The scale of the rebuilding programme was enormous and many of its concepts were new and innovative for that period. The end product, much of which is still in existence today, although in some cases significantly modified, stands as a monument to the Marquis of Pombal who initiated and organised it, to the architects such as Eugénio dos Santos and Carlos Mardel who designed it, and the workmen who constructed it. The origins of the buildings are found in the architecture of previous periods of austerity in Portugal.

At the end of this chapter, it becomes clear how the reconstruction of the city of Lisbon was the principal driving force behind Pombal's economic and social reforms.

Very little work has been carried out on the details of the design and construction of these buildings, the principles behind their construction and the way in which they evolved. The author therefore embarked on a detailed investigation of the buildings and their historical record in relation to the principal aims of the study listed in section I.1..

Placed in the context of the aim of this work, the next chapter explains the methodology adopted in order to achieve the objectives.

CHAPTER II.

SURVEY AND DOCUMENTARY SEARCH

II.1. Background

In 1962 Professor and Historian, José-Augusto França presented in Paris a thesis entitled "Une Ville des Lumiéres: La Lisbonne de Pombal". This impressive work describes the reconstruction of Lisbon after the 1755 earthquake by analysing its social, cultural and economic aspects. As in other "Enlightenment" developments in Europe, the Pombaline period is characterized by the predominance of rentable buildings. In this work little is said about the interiors or the construction of its rentable buildings. It was suggested that the rentable buildings were prefabricated but no details of their construction were given to support this suggestion. One main objective of the current study is to confirm or disprove this suggestion. Another aim is to classify the interior plans of the rentable buildings, and establish whether there was any evolutionary development in their layout, construction and ornamental details over the eighty year period during which they were built. This is particularly important, in that over time these buildings are being systematically destroyed. Another aim of this study is to classify the Pombaline rentable building as a style of Portuguese architecture, identifying its characteristics.

The evidence needed to confirm or otherwise the use of pre-fabrication, the existence of an evolutionary development and the definition of the Pombaline rentable building as a style of Portuguese Architecture, should be apparent, both in the details of the style and construction of the buildings and in existing historical documents. A detailed survey was carried out on a large sample of all the buildings and a search was made for historical documents from the period, in order to identify evidence relating to the specific aims of the study.

II.2.Introduction

In chapter I, accompanied by a summary of the History of Portugal is an overview of the development of the city of Lisbon from its beginnings to the 1755 earthquake. The description of the hecatombe was made based on "The Lisbon earthquake of 1755-British Accounts"(17). The first measures to rebuild the city, (taken by the Marquis of Pombal), and the proposals and concerns presented by the Royal Engineer (known as "Dissertations of Manuel da Maia") are kept in the "Livro IV das Intendências do Ministério da Justiça" (31) in Torre do Tombo. These were carefully analysed, in order to understand the procedures adopted during the reconstruction.

To better understand the rentable buildings, the author decided to study their possible origins in the previous and well established periods of architecture. Similarities with the modulated Pombaline façades were found in the simplicity, proportion and repetition of the preceding austere period of architecture, the Architecture "Chã" (1580-1700). Therefore the book, "A Arquitectura Portuguesa Chã"[34] of George Kubler, was consulted for source material.

To achieve the main objectives, the author attempted to discover how the mentors saw the rentable buildings, and to determine exactly how they were built. This formed the basis of the investigation of whether pre-fabrication was used and of how the buildings developed and evolved.

II.3. Definitions

The Pombaline period was dominated by rentable buildings, which are the subject of the current study, for this reason it is necessary to define the concept of the Pombaline rentable building.

The exteriors are defined in the "Dissertations" of Manuel da Maia (see I.8, Fig.79), whereas the interiors are not defined in any detail.

The "dissertations" suggest that a typical rentable building has a ground floor used for commercial or industrial purposes, with three upper residential floors and one attic floor later used for residential purposes, and these are characterized by a great austerity. At the beginning of this century, in most of the buildings located in the principal streets, two or three residential levels were added. For the purposes of this study, these buildings have been investigated, but their extensions have not, as they are not from the relevant period.

After the definition of the concept of the Pombaline rentable building, it was necessary to define an area for the study. The third part of the Manuel da Maia's "Dissertations" had defined the area to be reconstructed, (see I.8, Fig.58), but the reconstruction dragged on for many years and was not carried out completely as planned, so the actual limits of the urban area for this study must be clearly defined over the proposed plan for the reconstruction. For this reason an area was selected, which strictly followed the reconstruction plan and does not contain structures that withstood the earthquake. This flat and rectangular area is situated between the Rossio and the Comércio Square, plus a narrow strip of buildings in Arsenal Street, (see Figure 27). In this area all the buildings from before the earthquake had been razed to the ground, giving way to blocks of a regular geometry. For the purpose of this work, the Pombaline public buildings in Comércio Square and churches are excluded. In

addition, transition areas were also defined, where the plans proposed for the streets were not fully respected, or in some cases the plans were just modified by the widening of the streets. These are outside the defined area and are also excluded from the study.

In the area defined for this study (0.24 Km^2) (see Glossary, p.viii), usually known as the Pombaline area, there are 53 blocks comprising 400 buidings, of which the interiors of some had been systematically destroyed. Of these buildings, 85 of them are not Pombaline rentable buildings or are radically altered, thus only 315 are considered by the author to have kept their original characteristics. The author has analysed the interiors of 304 of these buildings, (for the purpose of this study the 315 Pombaline buildings are considered to be the total i.e. 100%) containing a total of approximately 1422 flats, ((170x2+108+26)x3). There are 170 (54.0%) buildings with two flats per floor, 108 (34.3%) buildings with one flat per floor, and 26 (8.3%) buildings for which two buildings share one stair (see location in Fig.102). The mansard flats are not considered due to the fact that at the beginning they were not designated as residential accommodation and the disposition of their interiors is irregular.

II.4. Basic knowledge about the buildings

To record and understand the architectural characteristics of these buildings is fundamental to the aims of this study. The exteriors, the elevations imposed and the interiors should reveal the intentions of their designers about compositions or size of components, in relation to a possible prefabrication. The interiors and exteriors should also reveal aspects related to dimensional coordination and possible features which indicate any evolutionary trends over the construction period.

The study of the buildings commenced by recording details of the exterior, (the elevations) because they were immediately visible and accessible and because it was thought there could be relationships between the exteriors and the interiors of the buildings which would help to understand the internal plan and design of the interiors.

At first sight the elevations of the blocks of the area seem to be similar, but on closer observation a certain number of design details, such as French windows, lintels, and mansards, are seen to vary from street to street and in some cases from one building to another. The regularity of the compositions was strictly adhered to in the important streets and squares but in less important streets their distribuition seems to be more varied.

Studied area	0,24Km^2			
Number of blocks	53			
Number of buildings	400			
Pombaline buildings	315	100%		
Visited buildings	304	96.5%		
○ Not recorded	11	3.5%		
● Single	108	34.3%		
Left/right	170	54.0%		
● Asymmetrical	94	29.8%		
● Symmetrical	32	10.2%	54.0%	
● Strictly symmet.	44	14.0%		
● Sharing stairs	26	8.3%		

Fig.102 -Location of buildings by classification

Knowing that the reconstruction was not done exactly as planned, the author decided to look first for the original drawings of the buildings which supported the text of the dissertations of Manuel da Maia for the reconstruction. This document is kept in the Arquivo Nacional da Torre do Tombo, (Archives where old documents are kept), known as Livro IV das Intendências do Ministério da Justiça(31). The author began the investigation at the Arquivo Histórico Municipal de Lisboa, (Archives of the Municipality), where copies of the original drawings to be consulted exist. The originals are kept in the Museu da Cidade (City Museum) in Lisbon. The elevations specified in these drawings were imposed by the authorities for the reconstruction, and as previously stated, the drawings were published as a catalogue for the exhibition "Lisboa e o Marques de Pombal", Museu da Cidade de Lisboa, Municipality of Lisbon, 10th November 1982. The catalogue was carefully analysed, and the buildings were selected by streets in order to see which streets the ones in the drawings corresponded to. Also details of the elevations proposed during the initial dissertations were examined. In a small number of cases some drawings showed three floors instead of the standard four floors. Clearly these must have been subsequently abandoned as no buildings with only three floors appear to have been constructed. The intention during this phase of the study was to try to find out exactly what the designers intended to build during the reconstruction. In order to find details of the elevations of all the buildings the following Archives were investigated but nothing was found:

Biblioteca National, (The National Library), section of Illustrations, Entre-Campos, Lisbon.

Amigos de Lisboa, (Association of the Friends of Lisbon), Açucar Street, Lisbon.

Arquivo Histórico do Ministério das Obras Públicas Transportes e Comunicações, (Archive of Ministry of Public Works), Comércio Square, Lisbon.

Serviço Geral de Obras Arco do Cego, (Local Department of Public Works), Lisbon C.M.L., Arco do Cego, Lisbon.

Gabinete de Estudos Olisiponenses, Estrada de Benfica, Lisbon.

Arquivo dos Monumentos Nacionais, (Archive of National Monuments), Comércio Square, Lisbon. In this archive the only drawings found related to the Comercio Square, which is considered to be part of the National Heritage.

Biblioteca e Museu da cidade de Pombal, (Library and the City Museum of Pombal)

As the designers of the Pombaline buildings were military men the "Arquivo Histórico Militar" (Military Historic Archive), Largo dos Caminhos de Ferro, Lisbon, was consulted, especially the documents of the fifth section (1736-76). Many military documents written by the Marquis of Pombal or the other designers were

found, but the only one relating to the Pombaline area was about the equestrian statue of D. José in the Comércio Square. Having failed in the search to find details of the totality of the elevations, the existing drawings were carefully studied in order to distinguish details and to compare with the existing buildings in order to find out if the plan was followed exactly. This study did in fact suggest that the original drawings were respected during the reconstruction. However it should be noted that the original drawings only cover a part of streets. During all this search not one interior drawing of a Pombaline rentable building was found.

For the study of the elevations the classification proposed by Professor França, in his book "Lisboa Pombalina e o Iluminismo", Bertrand Editora, Lisboa, Dezembro 1983 was adopted. Due to the impossibility of doing a complete survey of the elevations of all buildings, the author confirmed if buildings of each street were in proportion to the original drawings of the catalogue. For that purpose one building of each facade of a block was observed and recorded and the proportions were verified. In fact, they were all found to be in proportion to the original drawings, bearing in mind that all buildings have the same height as the Comércio Square buildings. A standard measuring tape was used to record dimensions. The measurements were taken horizontally on the ground floor and the first floor. The vertical heights of the ground-floor and the openings of the first floor were also confirmed. One by one the streets and buildings were observed and recorded photographically in order to verify the classification. Detection of new details and variations to compositions were noted in order to establish a full record of the buildings and the streets and produce a complete classification.

Also during this part of the study the author tried to confirm if the components and compositions of the façades were modulated or interchangeable.

As far as the interior plans are concerned, the author tried to find original drawings detailing the interiors. It seems that the interior plans were not imposed by the authorities which suggests that the interiors were built according to the requirements of the owners over a period of time. The ground levels, normally occupied by shops and warehouses are mostly identical. For the purposes of the investigation of the interiors, the author concentrated on the upper residential floors, and in particular the layout of the first floor, as well as the access staircases.

In searching for original drawings of the interior of the buildings, the author again investigated the Arquivo Histórico Municipal de Lisboa, Lisboa, (Archives of the Municipality) where exist documents related to the buildings of Lisbon, and then the Archive of the Museu da Cidade, (Lisbon Museum), but without success. The drawings found related only to the exteriors mentioned above, which were mandatory for the reconstruction. Here, the explanation given to the author, for the non existence of any original drawings of the interiors or any written documents about each building, was

because they were not imposed and the later documents containing plans which were produced for clients were destroyed in two extensive fires, (one on 10th June 1821 which destroyed the south side of Comércio Street, between Augusta and Ouro Streets where the public offices were located, and the other on 11th November 1863, in which a fire destroyed the archive of the Municipality building) (48).

Therefore, the above mentioned Archives were investigated again but nothing was found.

Due to the lack of success in finding any original drawings, the author decided to search the archives of the municipality Arquivo do Alto da Eira, Municipality of Lisbon, where documents are kept related to all buildings in Lisbon from the beginning of the century. The existence in these surveys of parts of old buildings are normally a result of alterations to the buildings. Most of the drawings which related to the Pombaline area were of the ground floors, because of the constant alterations of shops. Only a few cases had a complete survey which had to be checked "in situ", because normally the surveys ignored the original layout and only reported the latest alterations.

It was therefore necessary to do a new rigorous and complete survey. Knowing that the plans of the upper residential floors were similar at each level of a building, the author decided to survey only the first floor. If the first floor was inaccessible or modified, the author would then visit the upper floors in order to understand the plan of the first floor, because the walls are aligned vertically. The author decided to visit each building in the defined area and using an infra red device ("Sonytape"), to make a survey on the scale 1/400. The study of the interiors of houses was not easy because of the fears and suspicions of residents, as a result of the climate of insecurity in the area. Due to the vastness of the area, this survey took two years to complete after which almost all the buildings had been visited. A bona fide document with the author's credentials was issued by Escola Superior of Tecnologia, explaining to residents the objectives of the study. This was shown to every visited resident. In many cases it was necessary to visit residents on different occasions, in order to gain access to the interior, and nine buildings were found to be completely closed.

The verandas were not represented because they were registered in the elevations and their representation in the plan, would make the comparision of the interior plans more confused.

The drawings of the plans which the author has made are a unique and valuable historical record of the Pombaline buildings. To appreciate the importance of this survey, it should be noted that there are no existing copies of plans of the Pombaline rentable buildings, and the plans are completely different from one building to another. They are presented in Appendix 5 rather

than as a major chapter in the thesis, because of the quantity and detail of the material. During the survey, numerous notes were made and photographs taken of the internal architectonic details, variations and finishings, but these notes were more related to the finishings rather than the construction details, (see Appendix 3) in order to provide evidence regarding the possible prefabrication of components. It was noted from the variations in the interiors, that there are certain distinct types of stairs, which are classified in III.2, which suggest the existence of a possible evolution of the interior plans (see Chapter V).

During the survey the author also tried to identify the technical innovations introduced in these buildings (see section IV.1) in order to better understand them, in relation to the possible use of pre-fabrication, care being taken to record and observe dimensions, shapes, construction details and finishing details.

II.5. The Pombaline rentable buildings and prefabrication.

During the survey a number of major questions presented themselves to the author. These included the question of why modulated façades were employed, and how the general urban dimensions were established? Also as dimensional coordination was employed, was there interchangeability of components, were standard modules used as basic units and what combinations were created? In addition were there special marks or signs to facilitate assembly, why did the blocks have this or that dimension and how did the buildings relate to the vast Pombaline area as a whole?

Trying to prove the existence of possible prefabrication, the urban plan was first examined. Later the author's survey of buildings made it possible to identify particular innovations introduced by the rentable buildings, which influenced the shape of buildings. The survey also revealed interesting geometrical compositions and the use of a basic repeat unit of measurement exercised in the modulation of the plans, and in the cage structure and the design of the façades. Also the compositions and arrangements of tiles, iron work or masonry and their interchangeability were studied, for suggestions of dimensional coordination and possible prefabrication.

II.5.1. Documentary search

The search for documents was important in providing evidence of whether the components were prefabricated or were just those of a standardized construction process.

The documentary search of pre-fabrication started by analysing the references to prefabrication made by França[2], and the articles by Architect Porfírio Pardal Monteiro(died in 16.12.1957). The author found the following articles in Biblioteca Nacional: Os Portugueses percursores da Arquitectura Moderna e do Urbanismo, (s.d., Porto, Circulo Dr. José Figueiredo (Imp. Moderna Ltd) and Eugénio dos Santos, Percursor do urbanismo e da Arquitectura Moderna, (in Museu, V, nº11, Porto, 1949). These articles emphasise the importance of Pombaline Architecture as prefabricated construction but they were written without making any reference to documentation or factual reference or to any detailed observation or investigation. The author decided to contact the nephew the Architect António Pardal Monteiro to enquire about documents that could support the articles. In the reply (see Appendix 4.6) he said that the articles must have been supported by experimental knowledge of the subject which must have originated from oral tradition passed down by P. Monteiro's ancestors. In his letter reference was made to Manual do Convento, written by José Saramago, a book which described the construction of a large convent, Convent of Mafra, during the period before the earthquake. Howevèr no relevant fact was found relating to the Pombaline area in this book.

In Livro IV das Intendências do Ministério da Justiça (referred to before) references were found to some measures to encourage mass production and stockpiling of building materials and manufactured items, but without evidence of establishing any norms for components.

In order to avoid speculation and scarcity of materials, the decrees of 15th May1756 and 12th May 1757 make reference to free circulation of building components and to monopolies by some companies to produce building components (see section IV.2.2.). An edict of 29th June 1757 mentioned the existence of a stock which would guarantee the availability of the products but none of the documents mentioned imply pre-fabrication.

In the Arquivo Histórico do Tribunal de Contas, the document "Vários alvarás de criação de novas industrias1757/1829" (a charter about the creation of new industries) was studied but nothing was found.

Professor José Eduardo Capa Horta Correia, in his thesis "Vila Real de Santo António, Urbanismo e poder na política Pombalina[46], mentioned that some materials and components came from Lisbon and some from the North, which implies that some components used in Vila Real were similar to the ones used in Lisbon. His evidence was based mainly on documents of a single building contract held in Faro Notarium (a local government archive in the Algarve). However this is not substantiated and further evidence to support this proposal is not presented. The author tried unsuccessfully to contact Professor Horta Correia in order to ask for further information.

The author also made an exhaustive search in the Archives of Torre do Tombo for building contracts between 1760-1830. Twelve relevant contracts were found, in two huge Notarium Archives. These presented considerable difficulties because the contracts were written in archaic Portuguese with interconnected words and with a difficult calligraphy, (see Appendix 4.5). The author consulted specialists who demanded exhorbitant prices for translation, but without giving guarantees of a successful outcome. The author therefore decided to carry out his own translation over a period of a number of months and this objective was achieved. Some of these provided useful evidence of prefabrication.

II.5.2. Survey

The author's survey of the construction details of buildings included recording all marks, size of components, complexity and variation of the processes of construction, types of wood used, tolerances and forms and shapes which would make the assembly of components simple.

The Pombaline town centre is currently the economic centre of the city, where many companies, especially banks, have sought to establish themselves and have systematically destroyed or altered the interiors of the buildings. Up to now, little or nothing was known about the construction system employed in the buildings, but over the last ten years the author has been present during all instances of the destruction of buildings and has also visited buildings undergoing alterations in the area. The buildings were photographed and highly detailed drawings were made with all the construction details, thus creating a unique record of the construction system employed. It provides a unique opportunity to study the construction details of different buildings, from the foundations upwards. Due to the danger involved in carrying out this study, many documents were required to gain access, and it often proved difficult to obtain authorization to regularly visit the buildings, during the period of complete destruction. This reluctance to allow access was because, in Lisbon, if something of archeological interest is found during demolition on a site, all work has to be interrupted often for many months creating major economic difficulties for the builder. There is also the responsibility of the builder in allowing someone to visit the buildings during their destruction, and in a few cases they did not allow photographs to be taken. Although the destruction of buildings has been somewhat random the range of buildings destroyed has been quite diverse, so it has been possible to obtain a complete picture of the construction system and its variants since it

embraces buildings corresponding to 9 of the 12 categories proposed by the author in Chapter V. It is also possible to understand how certain details of construction are related to an established hierarchy, which with the passing of time and the waning fear of possible earthquakes resulted in changes in the construction details. Small alterations to buildings were also visited and recorded in order to obtain more examples.

The following lists the buildings that were studied during their partial or total destruction:

	Location	Type*	Total destruction	Partial destruction	Dates
A.	9-13, Correeiros Street,	4	x		08.95
B.	15-23, Correeiros Street,	7	x		08.95
C.	25-35, Correeiros Street,	3	x		08.95
D.	76-84, Augusta Street,	12	x		08.95
E.	86-94, Augusta Street,	8	x		08.95
F.	50-54, Ouro Street,	5	x		89
G.	56-60, Ouro Street,	9	x		89
H.	185-195, Douradores Street,	6	x		90
I.	85-91, Prata Street,	9	x		94
J.	2-8, Santa Justa Street,	11		x	93
K.	51, São Nicolau Street,	5		x	93
L.	75, Conceição Street,	9		x	89
M.	110, São Julião Street,	5		x	89
N.	185, Prata Street,	5		x	90
O.	107-111, Correeiros Street	9		x	90
P.	69, Ouro Street	3	x		90
Q.	179, Correeiros Street	7		x	95
R.	141, Augusta Street	4		x	96
S.	84, Sapateiros Street	8		x	96

* (see section V.2)

A complete description of the interior of these buildings was produced (see Appendix 3).

The importance of this survey cannot be overestimated due to the fact that the interiors of some buildings have now disappeared for ever without any other institution having made any record of the details. Some interiors had been changed during small maintenance jobs which normally involved alterations to kitchen and stairs to introduce lifts, or just removal of tiles for economic reasons.

Unfortunately no marks which could give an indication of the source of the components and their method of fabrication, resulting from fitting or identification of components, were found on any of the components examined.

A study of the individual elements of the buildings which gave them stability, was also carried out, which helped to provide a better understanding of the reasons behind some of the assigns (for example the composition of the spaces in a façade) or structural forms (for example the geometry of the "cage" or of the vaults), (see Appendix 6).

II.6. The Pombaline rentable buildings and their evolution.

The analysis of the interior of buildings during the survey revealed the existence of certain types of stairs which, when compared, suggested the existence of a possible evolution of the interiors. Due to the vast number of buildings, the author decided to study only plans of buildings with two flats per floor rather than one flat per floor. This had the advantage that in the case of two flats per floor it would be easy to identify any later alteration of the interior partitions.

After developing a classification that appeared to represent phases in an evolutionary sequence it was necessary to establish the dates when particular buildings and streets were constructed in order to verify this sequence. However as already indicated, it is impossible to determine the precise date of construction of the buildings as the archives where the documents were kept (Archive in *Comércio* Square), were destroyed by two extensive fires(48). Descriptions by foreign residents were also studied but comparing the information carefully, revealed them to be contradictory and unreliable (see Appendix 4.3) in addition to the fact that most of the descriptions are incomplete and are of little relevance.

In the Biblioteca National a book by Luis Pastor de Macedo, "A Baixa Pombalina"(16) was found, which gives some numbers for the reconstruction of buildings but unfortunately without any reference to particular buildings.

It was therefore decided to carry out a search of the Archives of Tribunal de Contas, where there was a collection of the tax register "Decima da Cidade de Lisboa e o seu Termo, 1760-1840,(Register of Tax Collection between 1760 to 1840), not published, and belonging to the Arquivo Histórico do Tribunal de Contas, serial volumes 0302 (streets), Lisbon). Unfortunately this collection is written in archaic Portuguese, is very detailed and includes registers of tax paid by people living in single rooms. It was compiled in separate volumes covering the different Parishes, in which in some cases parts of a single street belong to different parishes. Therefore due to the associated difficulties in extracting documentation from the archive information, it was decided to do the survey only at intervals of approximately 10 years, between 1760 (when work began) up to 1830 (when most of the streets had been completed, a fact confirmed later in the data from this Archive), and also to include one main street (Augusta Street), half each of two secondary streets (Sapateiros Street and Correeiros Street), and half each of two transverse streets (Conceição Street and S. Julião Street). The number of the buildings in existence in each selected period was determined as well as the names of the owners, but it was not possible to locate the exact buildings, as the order of the register has no relation to the order of numbering of the buildings in their location in the streets. The tax register was compiled in order to

record payment by people living in the buildings rather than the owners of the buildings (i.e. these people must have been known to the authorities of each parish). Corner buildings presented a further problem because the external facades were on two streets and these streets or part of them may have been in two different parishes. Thus the number of buildings from the tax register was greater than the true number. For example, in 1790, Augusta Street had 71 buildings listed and later only 51. Although individual buildings could not be identified comparisons were made between the numbers found in the archives during each period and the number that actually existed on final completion of the construction programme. This gave a general picture of the progress of rebuilding different streets, and revealed that the major period of reconstruction was between 1760 and 1830.

A colour coded plan of the Pombaline area was produced by the author (see Fig. 305) in order to see if the phases proposed by the author could be correlated with the chronology of the reconstruction and with their distribution inside of blocks, and their location, size and shape.

Historical factors were analysed in order to determine whether historical events could have interfered with the possible evolution of the buildings. Also finishing details of buildings belonging to the different phases were compared in order to detect variations or similarities which would have supported an evolutionary sequence.

In order to obtain more information about possible pre-fabrication, the author, using the names of the owners of the buildings from the tax collection records, attempted to find building contracts in the Archives of Notarial Doccuments of Torre do Tombo. Some were in fact found, but unfortunately they were not related to the Pombaline buildings.

II.7. Investigations of other contemporary "Pombaline" developments within Portugal

In his book Lisboa Pombalina e o Iluminismo, França mentioned the existence of other "Pombaline" developments in Portugal, at Vila Real de Santo António in Algarve, at Porto Côvo in Alentejo, at Manique do Intendente North of Lisbon, and in a part of the city of Oporto, Porto dos Almadas. Although the subject of this work is not Portuguese "Pombaline" developments in general but is about the rentable buildings in the Pombaline quarter of Lisbon, it is useful to examine other contemporary developments for which the constraints and priorities imposed by the earthquake were absent. These developments were chosen. The first was Vila Real, the second a much smaller development Porto Covo and the third Manique do Intendente.

Vila Real of Santo António is described in the thesis of Professor José Eduardo Capa Horta Correia, "Vila Real de Santo António, Urbanismo e poder na política Pombalina", presented in Universidade Nova de Lisboa in 1984. This work contains much historical background information and also detailed information about the architecture of the buildings. After reading the mentioned work the author made many visits to Vila Real particularly to sites where alterations to buildings were being carried out which allowed details of the construction system to be obtained, making it possible to compare this with the Pombaline rentable buildings in Lisbon.

The author also searched for references to Porto Côvo in Arquivo da Torre do Tombo and Biblioteca National. The ones found were: Arquitectura Popular Portuguesa, Porto Côvo, 3rd edition, vol.3, p.156, Associação dos Arquitectos Portugueses, Lisboa 1988. and in Municipality of Sines Porto Côvo, Gabinete de Informação, Câmara Municipal de Sines, n. d.. The references described a possible initial plan attributed to António Martim Quaresma, but this was completely different from the actual existing buildings. The Author had therefore to make a complete survey of the buildings, including the architecture and the form of construction.

It appears to be generally accepted by architectural historians (6) in Portugal that Pombal´s Superintendent of Police (a hated and feared man) Pina Manique owned land in Manique do Intendente and developed that land probably towards the end of the development of the Pombaline rentable buildings. It might therefore be expected that similarities would exist between these later developments. In the search of archive material the author was able to find only one document relating to the development of Manique do Intendente. This was Azambuja, Manique do Intendente, published by Pelouro do Turismo, Câmara Municipal da Azambuja.

II.8-Summary

This chapter has outlined the approaches adopted and has described the methods and techniques employed, to achieve the major objectives of this study. This has involved a detailed survey of the architectural and constructional details of the majority of the buildings in the Pombaline quarter of Lisbon.

The survey has recorded in the form of photographs, drawings, numerical data and written observations a comprehensive description of the buildings for further analysis. It has in addition included an extensive search of historical archives and has attempted the interpretation, and also is some cases the translation of a wide range of historical documents relating to the Pombaline buildings.

From the information obtained the next chapter identifies the origins of Pombaline architecture, and defines the architectural characteristics of the Pombaline rentable buildings

To investigate the origins of the composition of the façades created and imposed by the designers of the reconstruction, it is necessary to compare the architecture and style of the Pombaline buildings with those of previous periods of Portuguese architecture taking into account the prevailing economic situation in the country.

The study of the architectural characteristics begins with an analysis of the imposed elevations and the existing elevations in terms of their details. From an existing classification a more complete classification is proposed. This analysis is important in determining the degree of standardization of the elevations and its influence on the variation of interior plans.

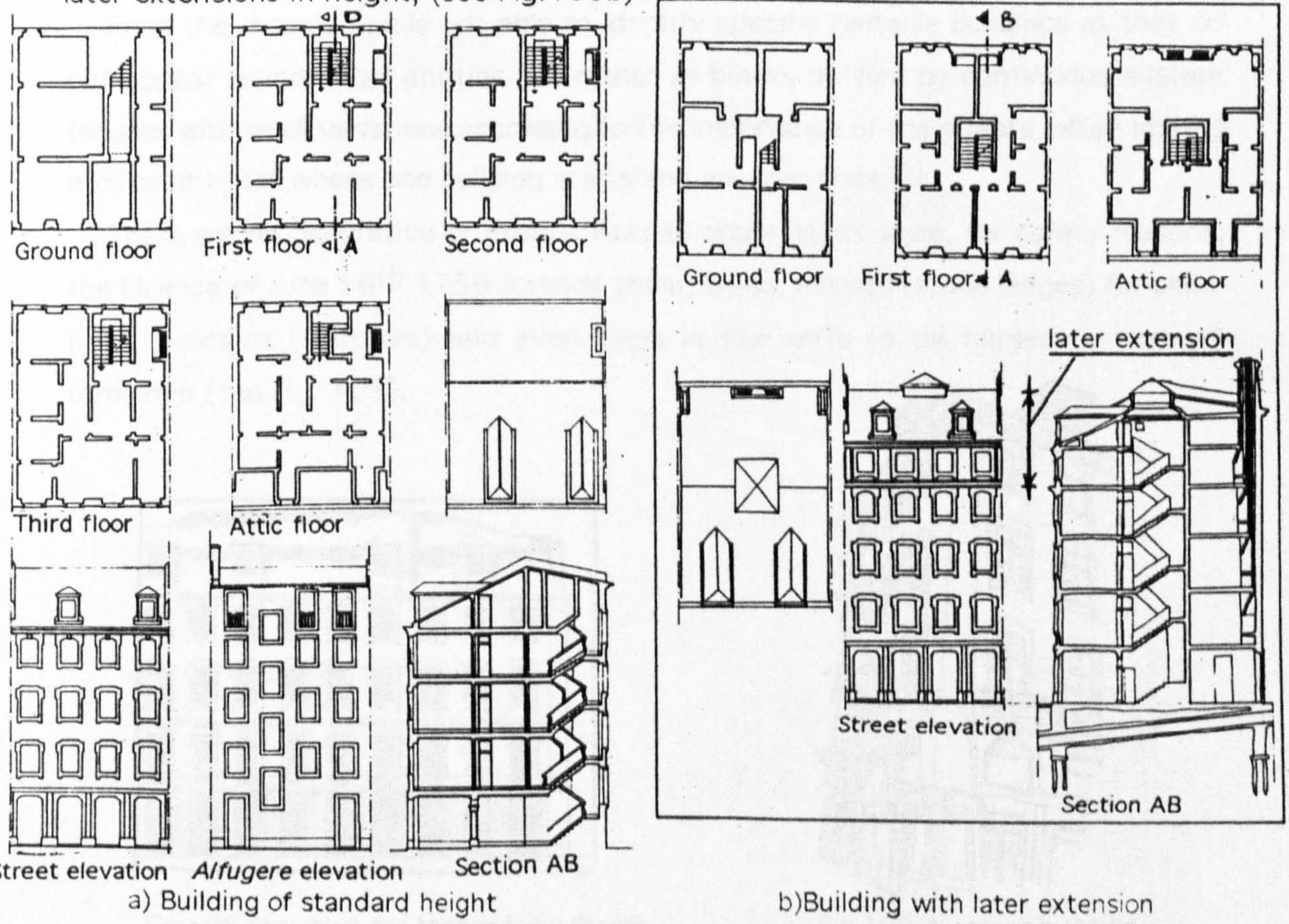
Also care is taken to describe the interiors of most of the buildings and identify aspects which influence and control the distribution and layout of the interiors such as dimensions, interior lighting and the sharing of staircases. The designation of particular typologies enables a classification system to be developed for the interiors of the rentable buildings.

CHAPTER III-GENERAL ARCHITECTURAL CHARACTERISTICS OF THE POMBALINE RENTABLE BUILDING

III.1. The exterior of the buildings.

As previously established the architectural style of the rentable building referred to as "Pombaline", grew out of the need to house rapidly a large population and to reconstruct the city quickly. It is characterised generically by its economy of style, its solidity, its regularity and its simplicity,(2)(see Fig.103).

The Pombaline rentable buildings comprise 448x3 flats, contained within 315 units (buildings) grouped into 53 blocks, located in the Pombaline reconstruction area as defined in I.4.2.. Each rentable building has a commercial ground floor and three residential floors. For the purpose of this study buildings are also included with later extensions in height, (see Fig.103b)



a) Building of standard height b)Building with later extension

Fig.103-Example of two Pombaline rentable buildings

The Pombaline rentable building has very specific characteristics in both the exterior and the interior form as well as in the system of construction, although many buildings have been modified over time. In addition outside the "Baixa Pombalina", whenever the building type was repeated in new urban areas, it was adapted and at times some of its characteristics were altered or even eliminated. However, all subsequent drawings by the author attempt to show the buildings as originally built, and ignore later alterations.

Fig.104-Number 2, 24th July Avenue

França has indicated number 2, Avenida 24 de Julho as a representative type for the Pombaline rentable building, (2) (see Fig.104).

From the outside one is not able to identify specific rentable buildings as they do not appear as individual entities but rather as blocks defined by continuous austere façades with small variations according to the importance of the streets, often making it difficult to tell where one building starts and another ends.(4)

There are no decorative or even utilitarian appendages since, for safety reasons, the Licence of June 16th 1759 forbade them; steps, *mísulas* (stone ledges) for plant pots, *gelosias* (shutters) and even rings in the walls to tie horses to were all forbidden (see Fig. 105).

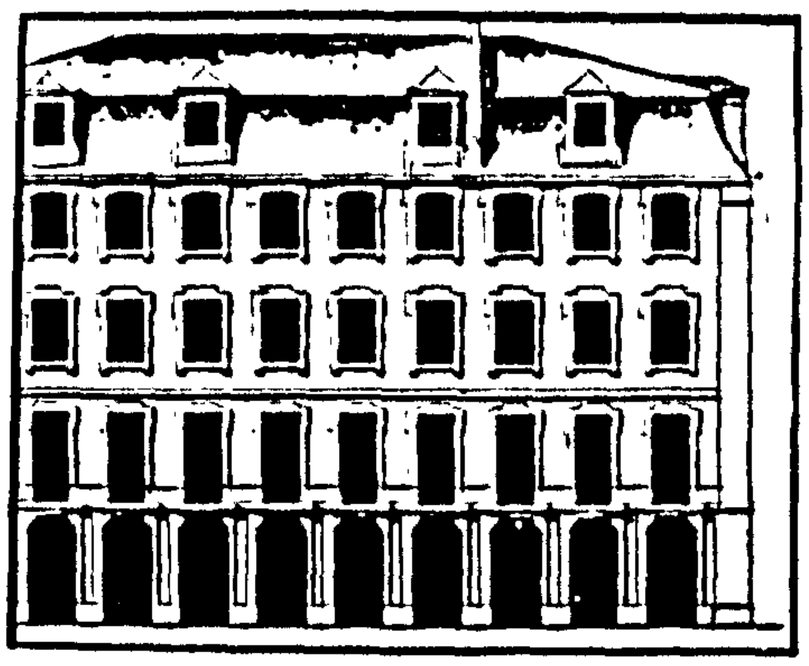


Fig.105-Elevation for Misericórdia Street

Fig.106-A corner building

In the Pombaline rentable buildings the design of the façades follows a rigid scheme. Visual enrichment or conversely impoverishment of the façades is limited to variation in small details. The variations in the façades do not occur in individual buildings or blocks but according to the "hierarchy" or relative importance of the streets.
The design of the façades in the principal streets is more elaborate than that seen in the secondary and side streets.

The rectangular blocks generally run north-south and define both main and secondary streets running in that direction. The ends of the blocks which normally comprise two buildings (occasionally one) define the transverse street. The facades of these buildings sometimes adopt the facade of the main street and sometime adopt the facade of the secondary street. If there are two end buildings adjoining a main and secondary street the one on the main street adopts the facade of the main street and the one on the secondary street adopts the facade of the secondary street. If however there is a single end building it can adopt either facade, (see Fig.106). The survey carried out by the author identified a number of general characteristics which define the exteriors of the rentable buildings. These are:

i)A scheme for the façade, including four composite levels beneath a cornice, which is of the same height as that of the buildings in the Comércio Square,[31](see Fig. 107).

Fig.107-Partial elevation of Ouro Street

ii)A cornice which runs all the way around the buildings and which, above the pilasters forms a small capital. The joint between cornices of different buildings in a level street is perfect.

iii)The corners of the blocks are decorated with stonework pilasters, (see Fig.108).

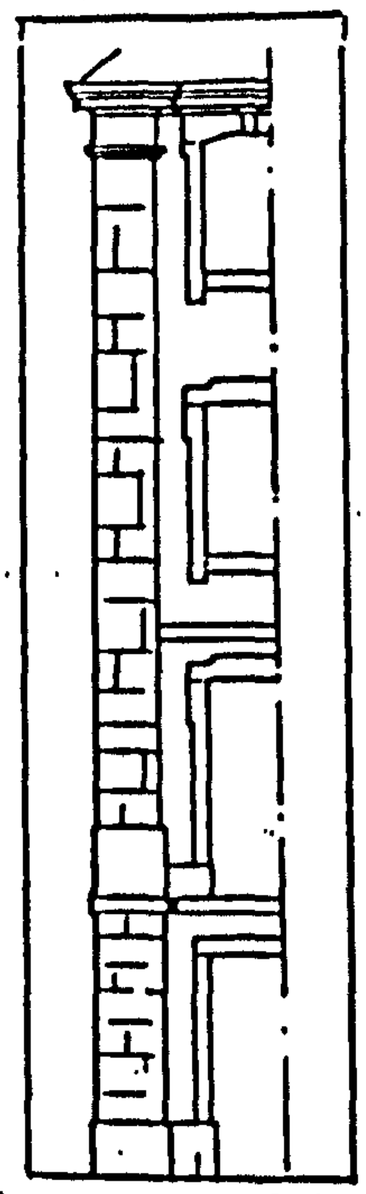


Fig.108-The corners of the blocks

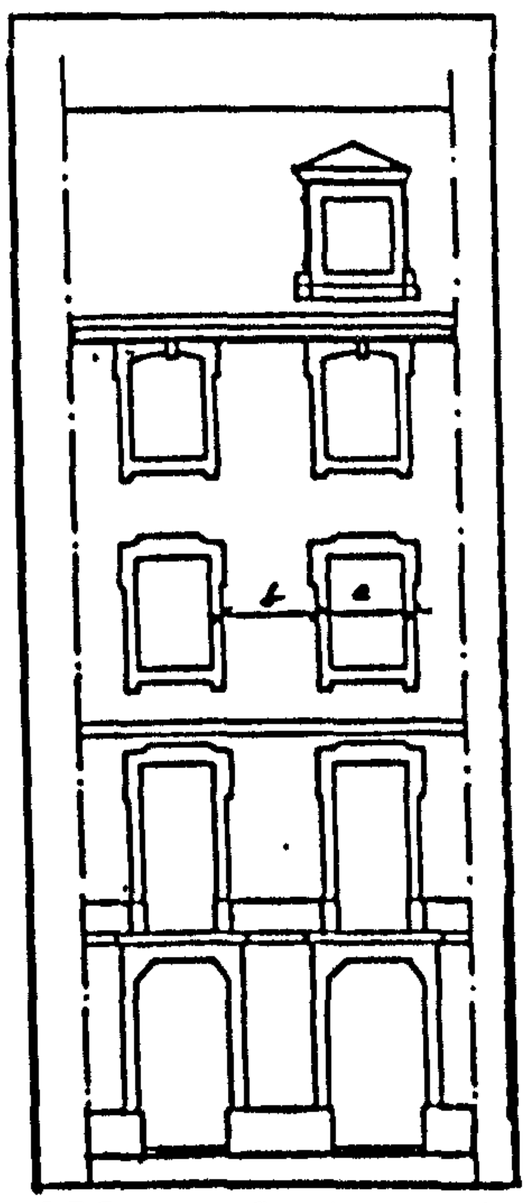


Fig.109-a, *vaðs* ; b, *nembos*

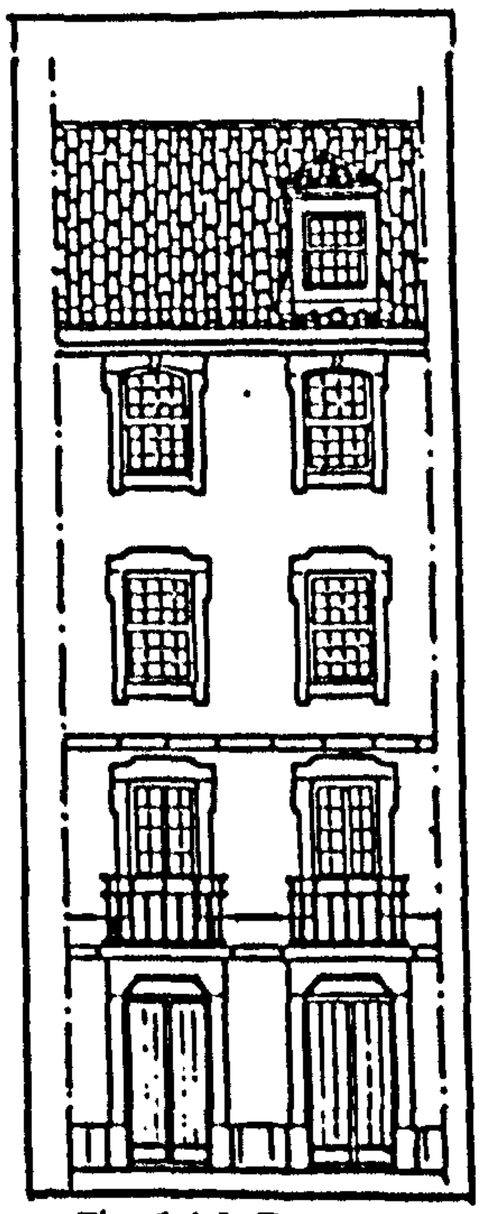


Fig.110-The perfect alignment of the masonry.

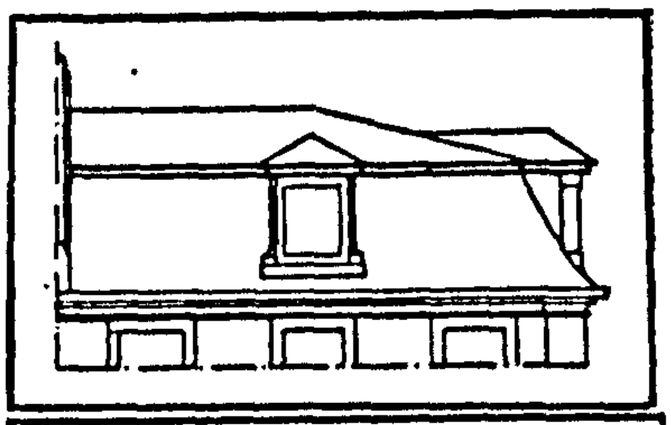
iv)With the exception of the ground floor, there is perfect alignment of the masonry both horizontally and vertically, (see Fig. 110).

v)The width of the *vaõs*, (window spaces), on the higher levels is the same as that of the *nembos*, (space between windows), (see Fig. 109).

vi)There is an attic storey, set back from the others above the cornices which, in the main streets and squares takes the form of a mansard roof, while elsewhere it takes the form of a hipped roof, (see Fig.111 and 112).

vii)The hipped and mansard roofs have dormer windows set back from the face of the wall with small hipped roofs over them.

Fig.111-Mansard roof



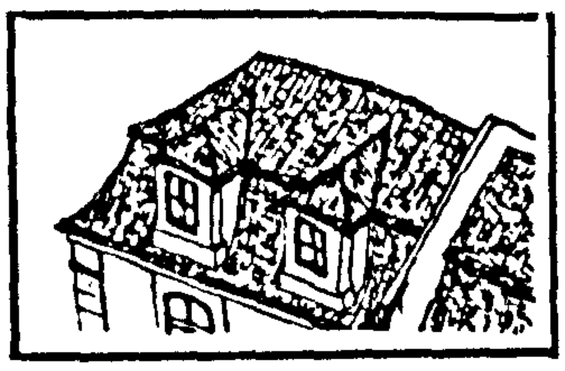
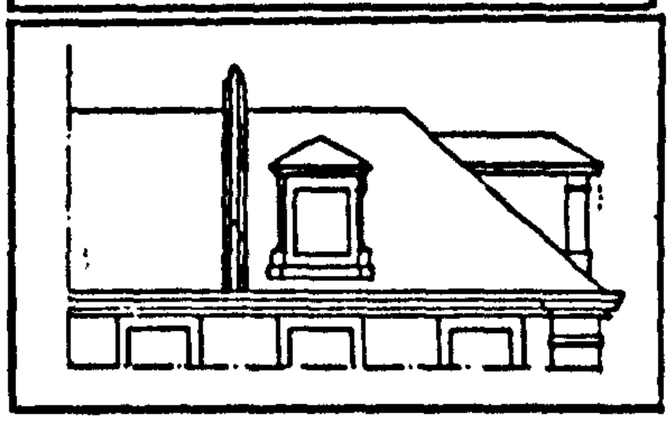


Fig.112-Hipped roof



viii) On the third floor the windows have waist-level sills and in the main streets they have arched lintels with small decorative keystones, (see Fig.113).

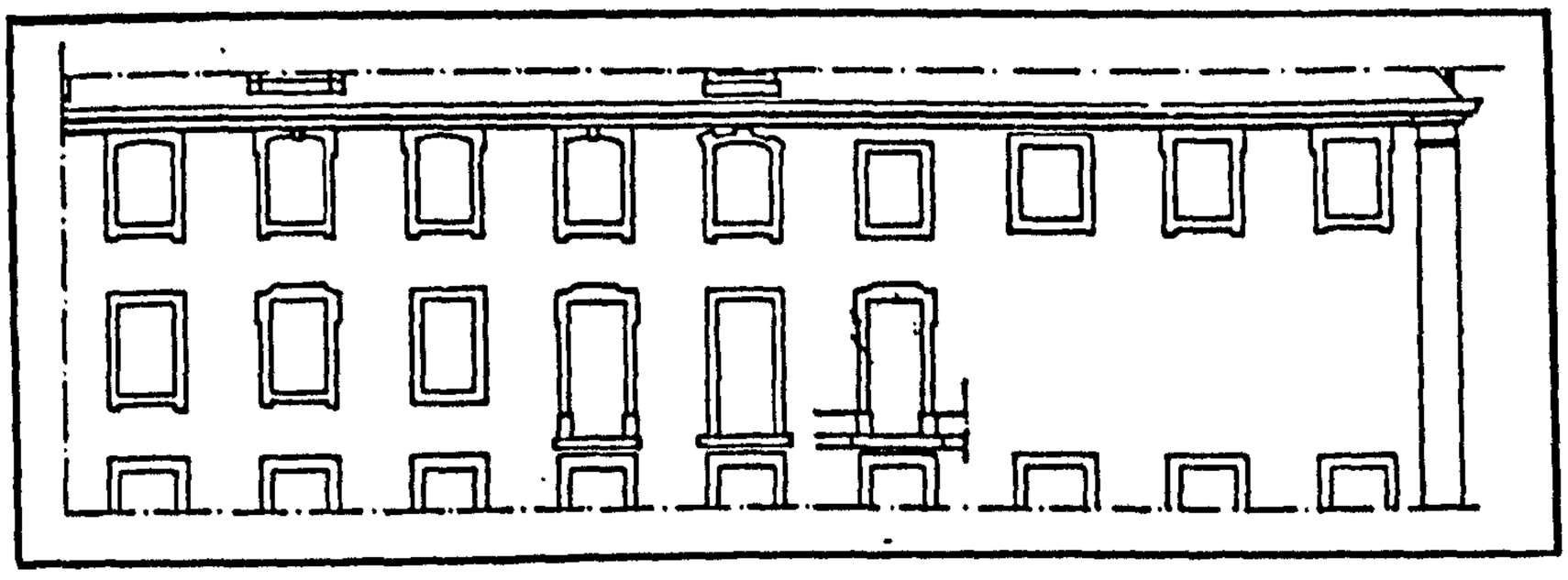


Fig.113-Typical elements (windows) for second and third floor.

ix) On the first floor in the main streets there are french windows, with iron balustrades, whereas in the secondary streets the windows all have waist-level sills, (see Fig.114).

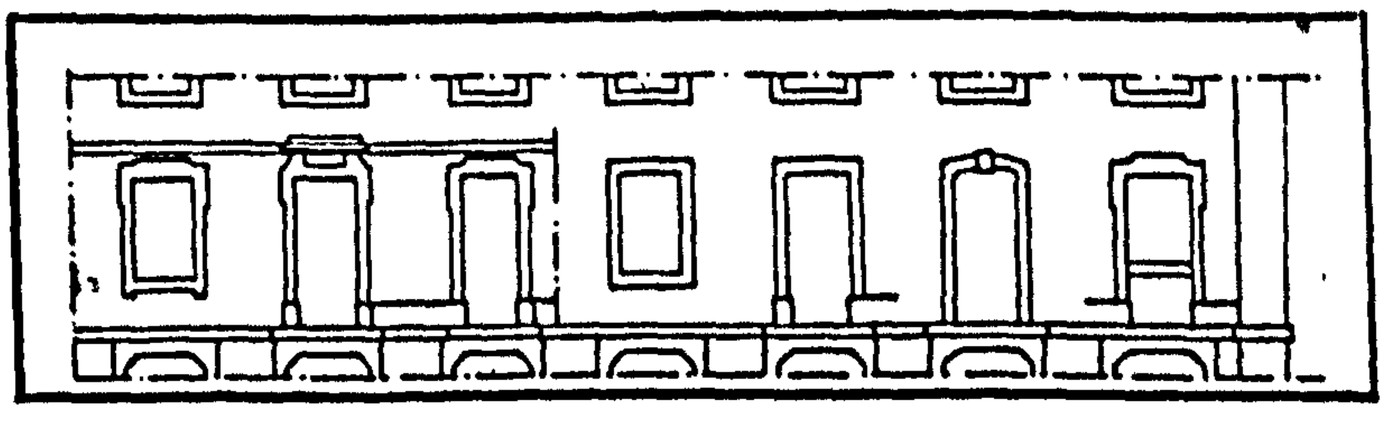


Fig.114-Typical elements (windows) for first floor.

x)At ground floor level the *vão*, (window space) is wider than at higher levels and this floor is normally higher than the rest, sometimes including a *sobreloja*, (mezzanine level); in these cases the ground floor and mezzanine level openings are combined into a single element, (see Fig. 115 and 116).

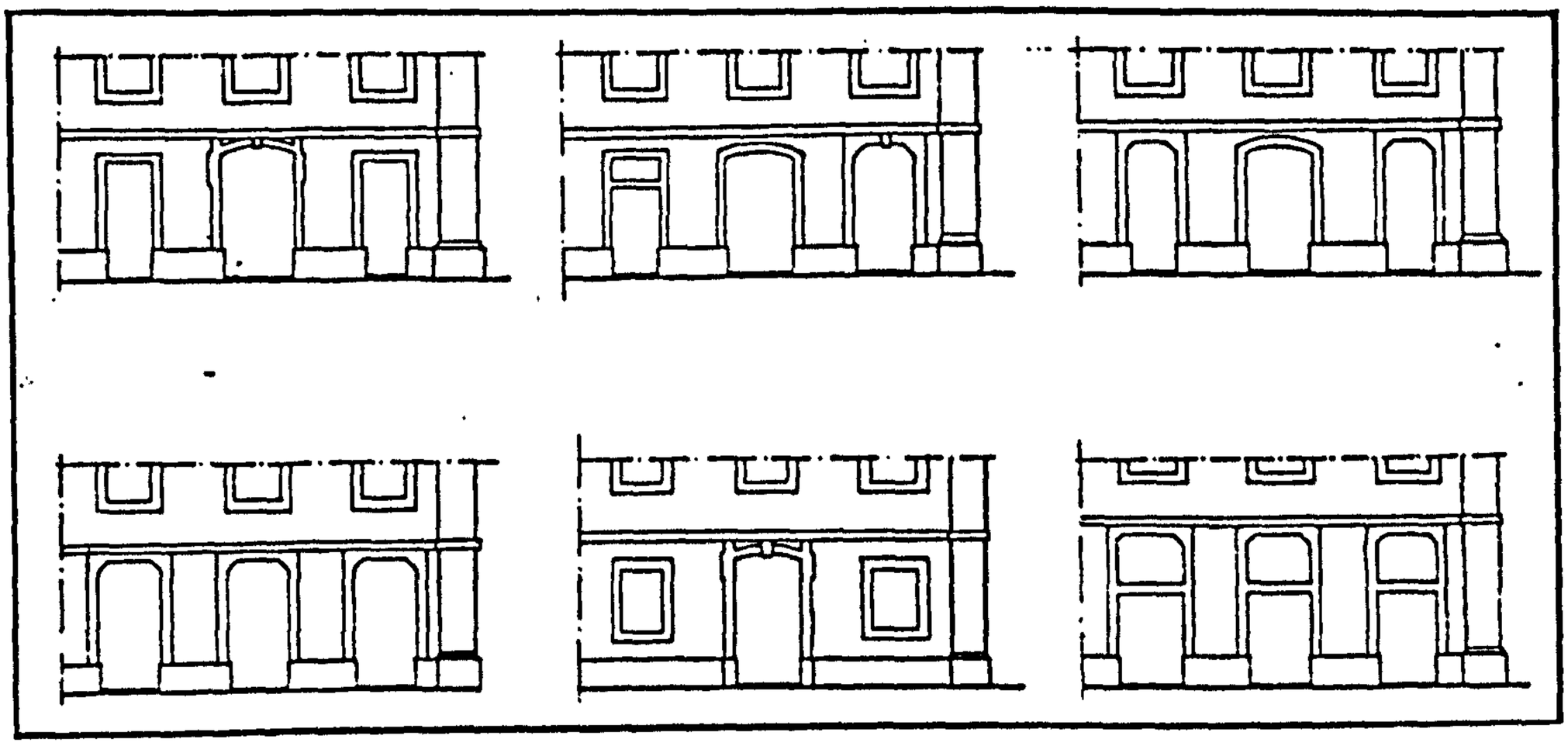


Fig.115-Typical elements (windows) for ground floor 1.

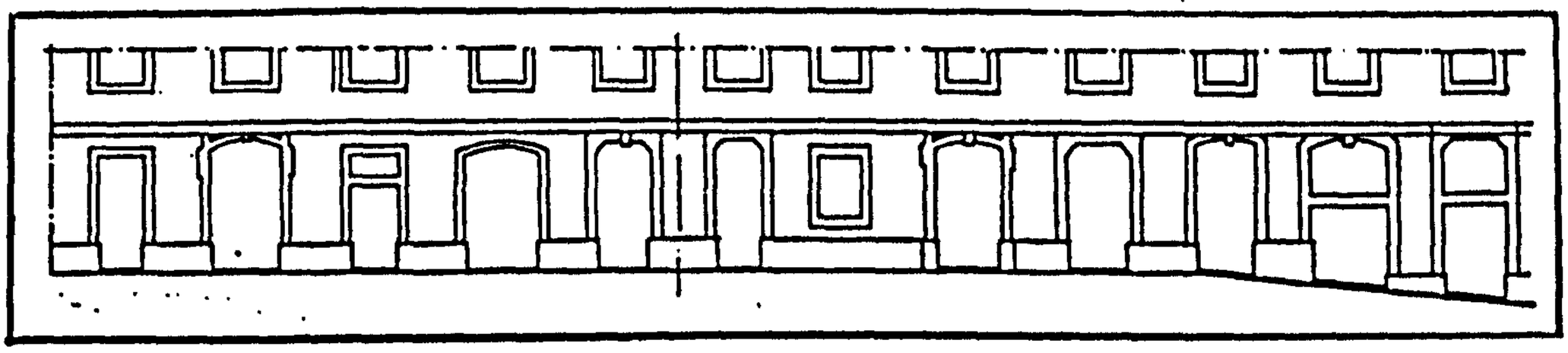


Fig.116-Typical elements (windows) for ground floor 2.

xi)The ground floors show fewer similarities but rather multiple variations in order to adapt the buildings to the changes in the gradient of the streets, (see Fig.117). The maximum gradient of the streets is 14 º. The changes of properties occurred between windows and perpendicular to façades.

xii)Above the rooftops the party walls are taken up as parapets to form fire barriers, which are the only real indication of the limits of the property or building, (see Fig.118).

xiii)The original colour of the façades was ochre.

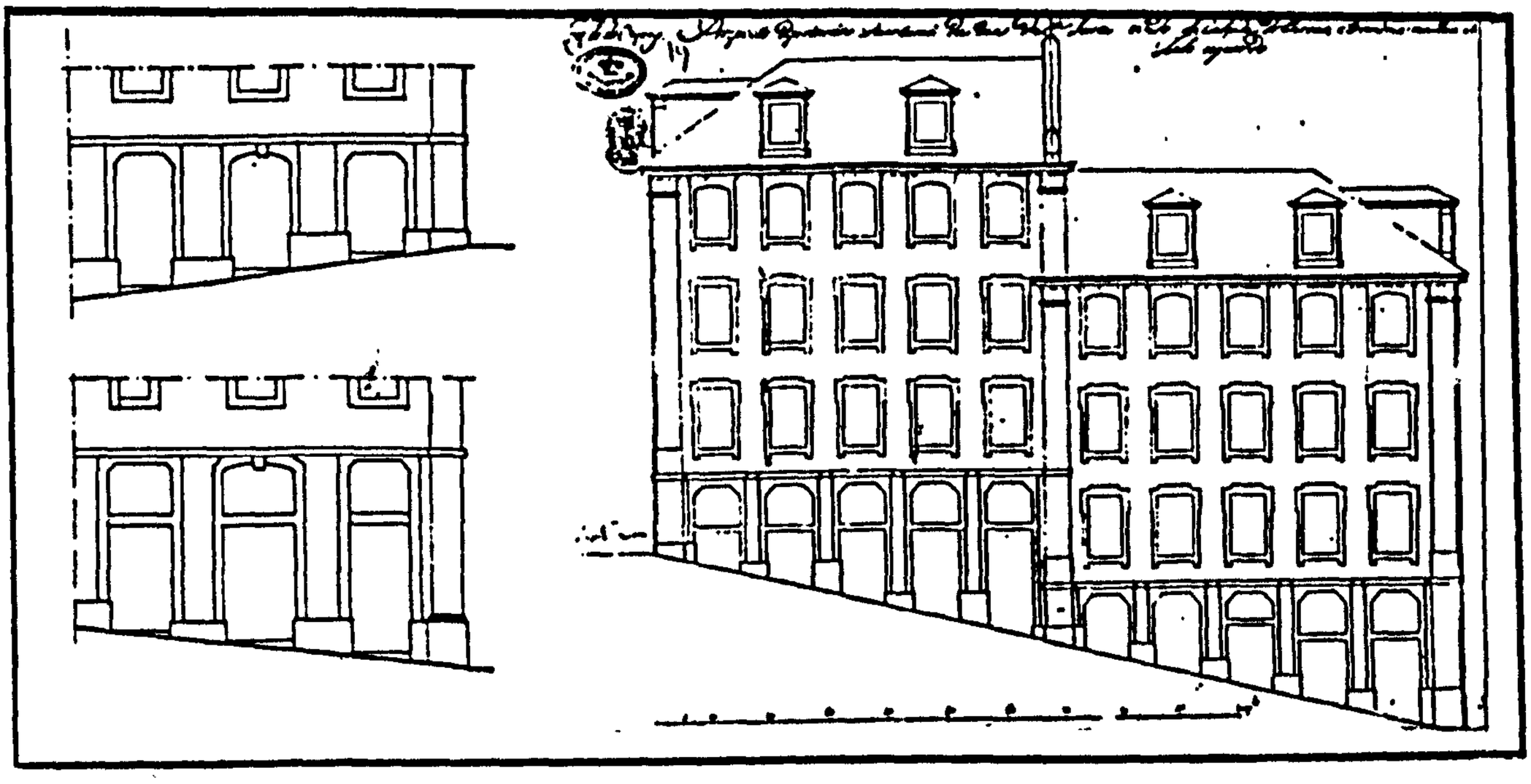


Fig.117-Adaptation of the buildings to the gradients of streets

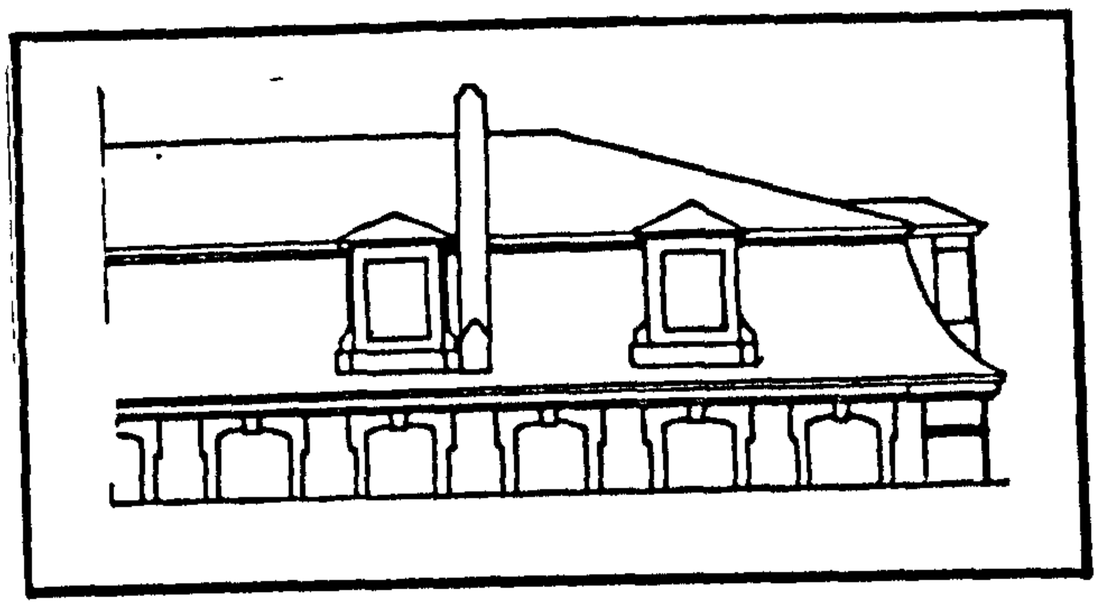


Fig.118-The fire barriers above the roofs

The different types of façades in the Pombaline area form a hierarchic system in which five types have been identified by the author, each type with its own specific façade design. There were also some isolated examples of different designs which can be described as hybrids. Examples of the five types and their characteristics are listed below.

Type 1-Important streets and squares,(*Arsenal* Street, *Corpo de Deus* Square, *Rossio* Square and *Município* Square), (see Fig.119 and 120).

The main characteristic of type 1 is the existence of a straight pediment with the appearance of a corbel on the upper parts of the lintels of the first floor windows.

Other characteristics are:

i)A stone string course connecting all the pediments. This string course is never seen in a secondary street, being exclusive to the main streets or those of greater importance. It seems it served as a point of reference on dark nights.

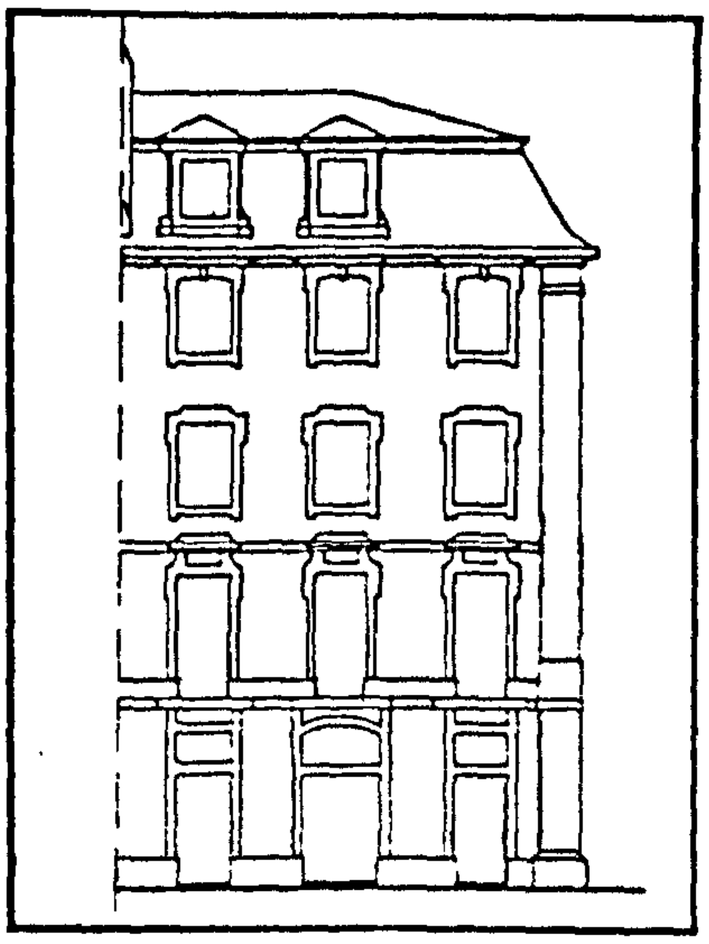


Fig.119-Type 1 façade

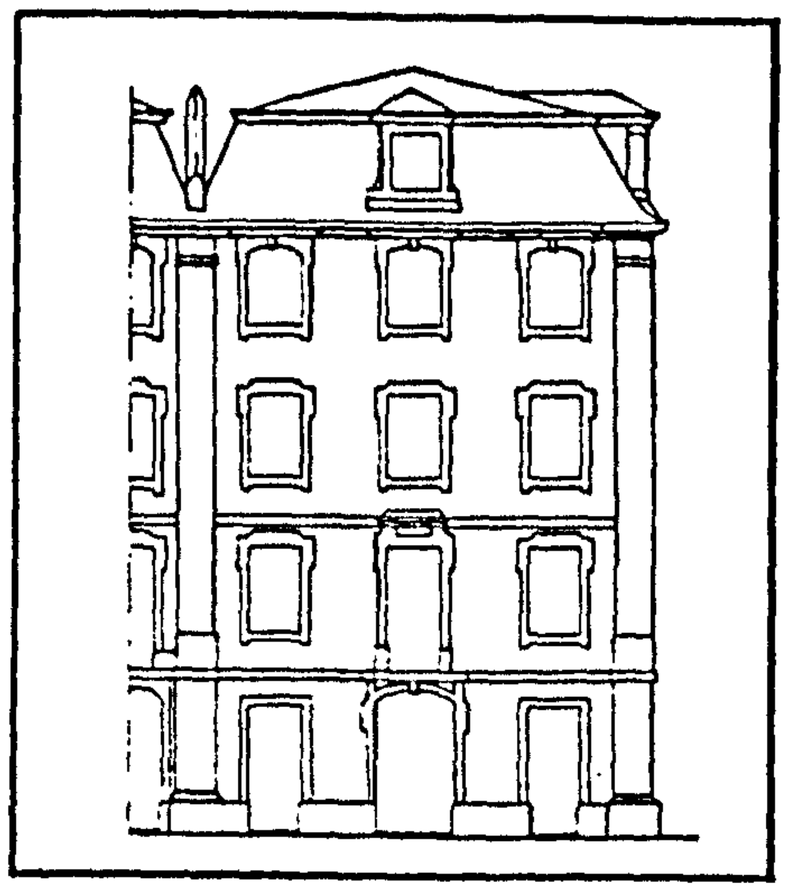


Fig.120-Variation of type1 façade for *Rossio Square*

ii)All the first floor windows are french windows connected by a narrow band in stone, (except in *Rossio* Square where the french windows alternate with normal ones).

iii)The lintels and the jamb stones of the french and normal windows have decorative shaped cuts.

iv)In the normal windows the jamb stones project below sill level, simulating props.

v)The lintels on the third floor windows are embellished with a key stone and their soffits are curved.

vi)Above each window on the third floor the lower part of the cornice projects, forming a capital.

vii)In *Arsenal* Street the portals at ground level have polygonal decorative panels in the upper part.

viii)The roof is a mansard shape, except in the *Municipio* Square.

Type 2- Main streets,(*Augusta, Ouro, Prata and Comércio* Streets), (see Fig. 121 and 122).

The composition is very similar to that of type 1, with the exception of the following features:

i)The straight pediments disappear, however the string course which normally would connect them remains as if to mark the line of the second floor.

ii)In this type the roofs are not the mansard type.

iii)The dormer windows have small scrolls on either side.

iv)On the ground level the portals may or may not have panels in the upper part.

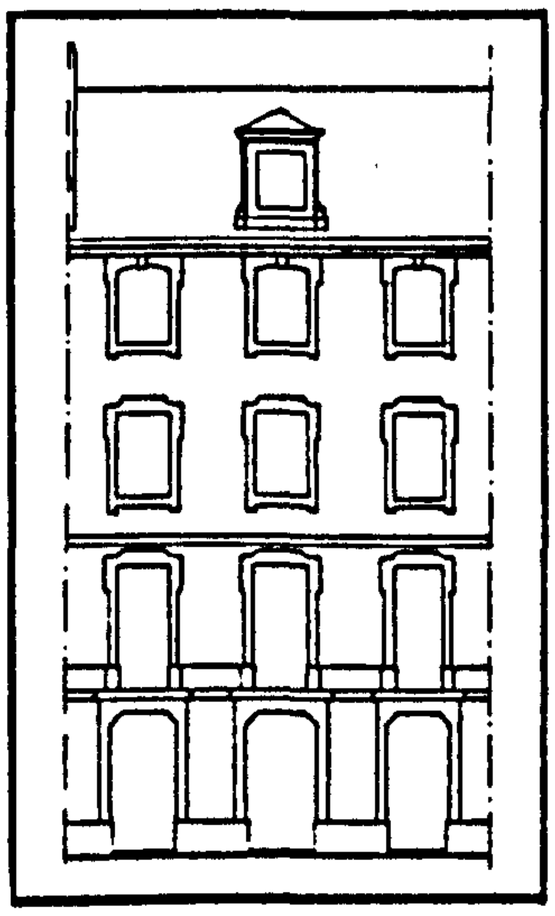


Fig.121-Type 2 façade

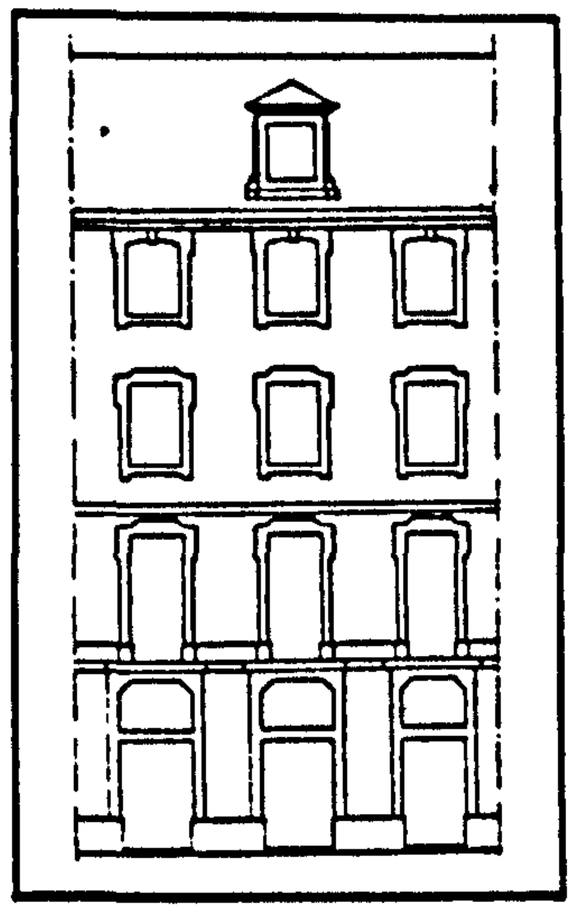


Fig.122-Type 2 façade, with a variation on the ground floor where the portals have panels

Type 3 - Main square and principal alleys, (*Figueira* Square, *Comércio* and *São Nicolau* Streets), (see examples Fig.123, 124 and 125).

The composition is significantly simpler than type 1.

i)The first floor windows have normal height sills.

ii)The pattern of the dormer windows can be continuous or alternate.

iii)The dormer windows have a small balcony guarded by a low parapet.

iv)The stone string course at first floor window head level exists only in *Figueira* Square.

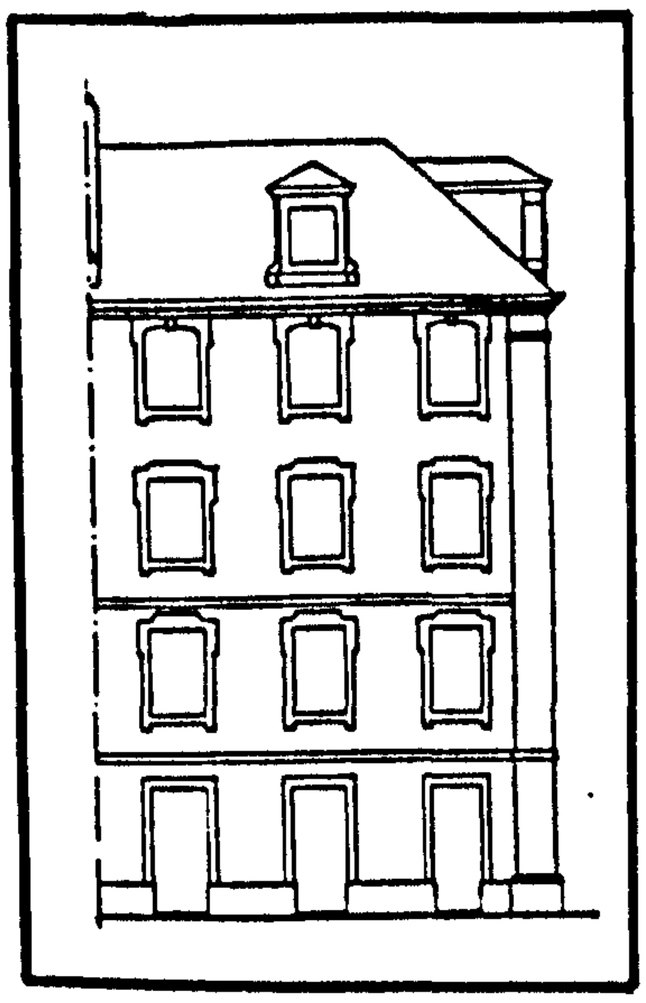


Fig.123- Type 3 façade-1

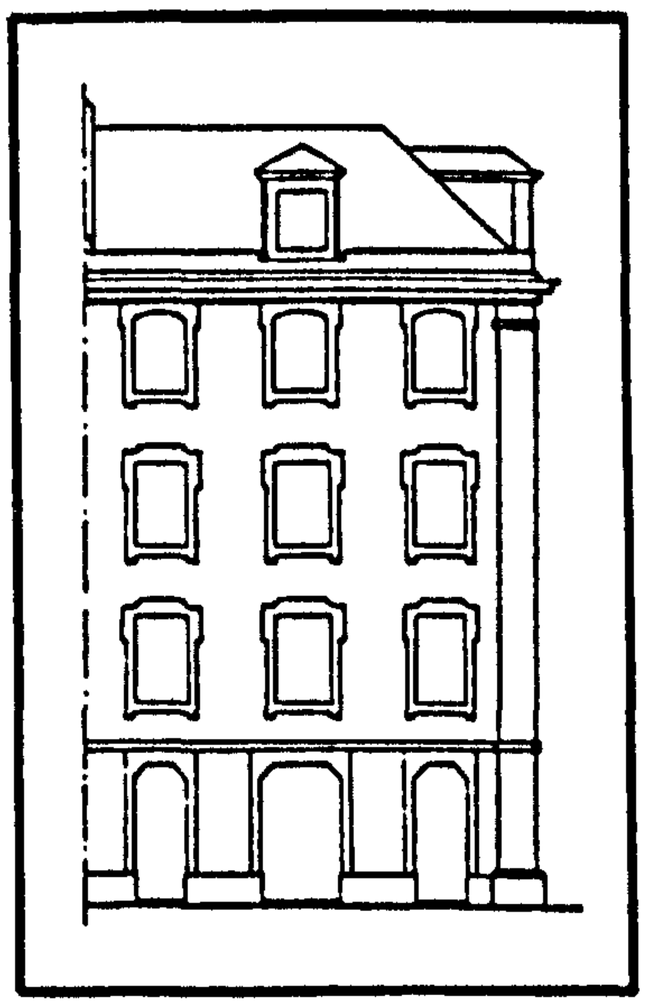


Fig.124- Type 3 façade-2

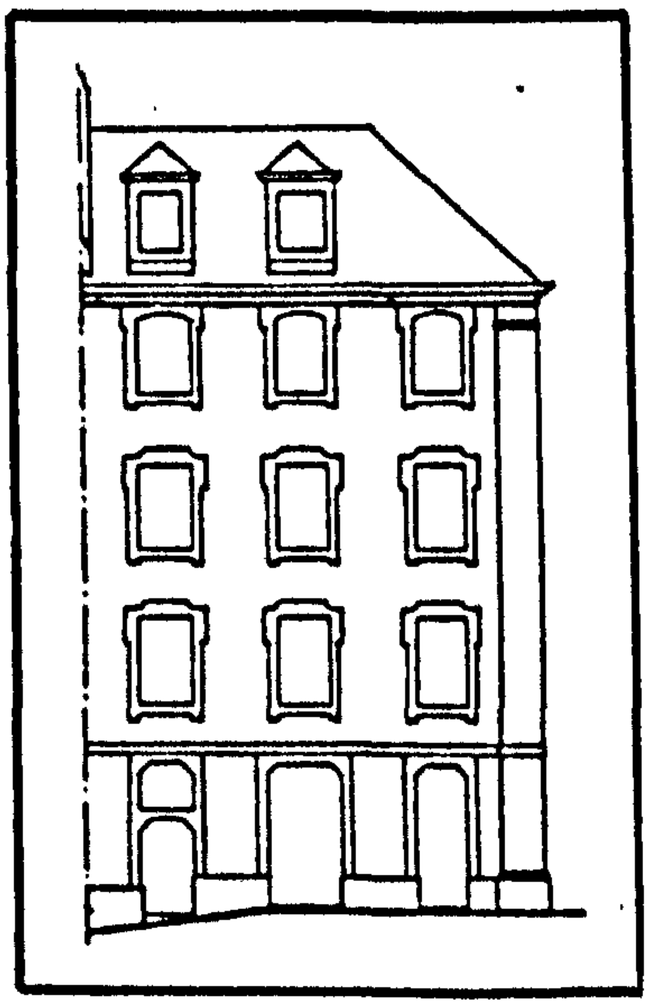


Fig.125-Type 3 façade-3

Type 4 - Secondary streets of some importance, (*Fanqueiros* and *Madalena* Streets), (see Fig. 126 and 127).

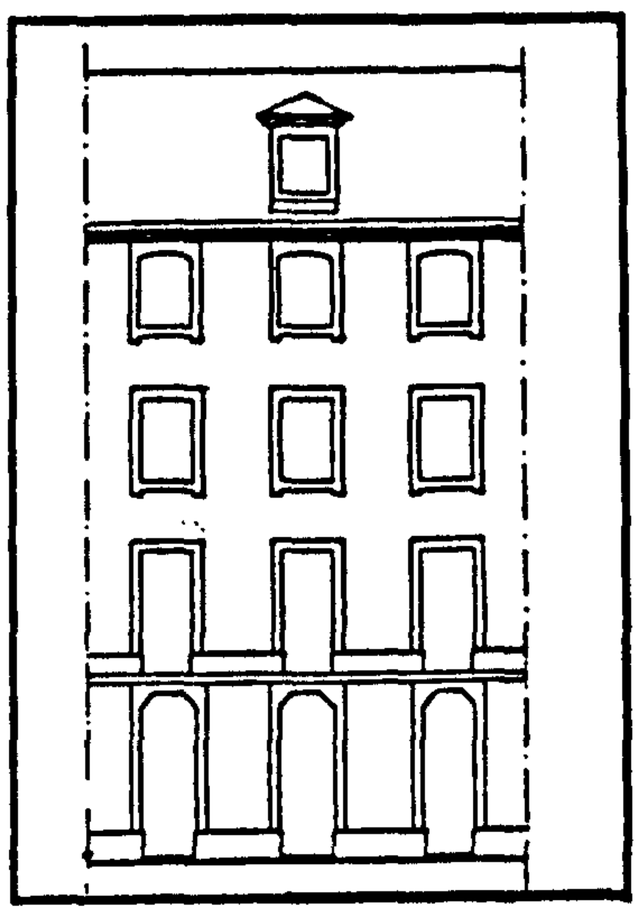


Fig.126-Type 4 façade

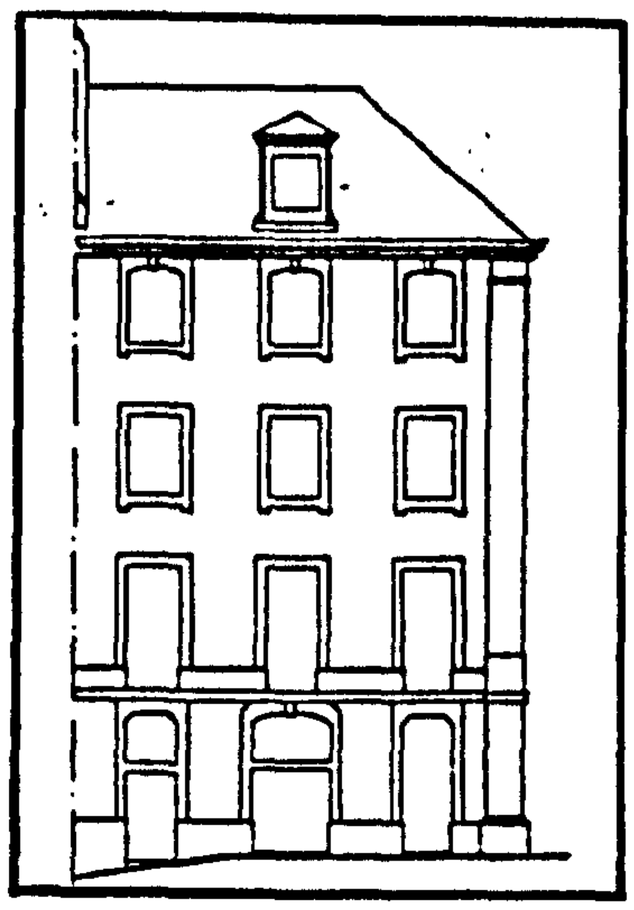


Fig.127-Variation of type 4 façade

In this type the composition is even simpler.

i)The lintels are rectangular except for the soffits on the ground and third floors.

ii)The first floor windows are still french windows with or without a connecting band in stone.

iii)There is no stone string course at the higher level.

iv)The keystones also disappear in most of the cases, as do the scrolls on the dormer windows.

v)There is no projection of the cornice above the third floor windows.

Type 5- Less important secondary streets, (*Sapateiros*, *Correeiros*, *Crucifixo*, *Douradores* and *Nova de São Domingos* Streets), (see Fig.128, 129, 130, 131, 132 and 133, on next page).

In this type of composition the fitting of the windows is clearly more utilitarian and also less disciplined. This is characterized by:

i)The lower edge of the lintels over the third floor windows is no longer curved.

ii)The jamb stones no longer project below the sills.

iii)In some cases the first floor windows are not french windows but normal ones. In other cases there are french windows on the second level (continuous or alternating).

iv)In *Douradores* Street in most cases the ground floors incorporate a mezzanine level.

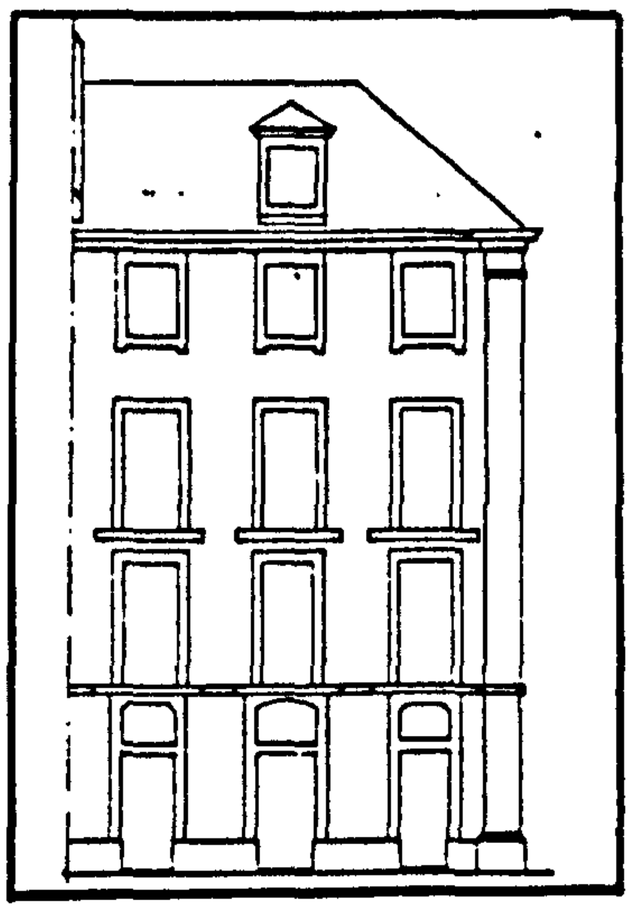


Fig.128-Variation of type 5 façade-1

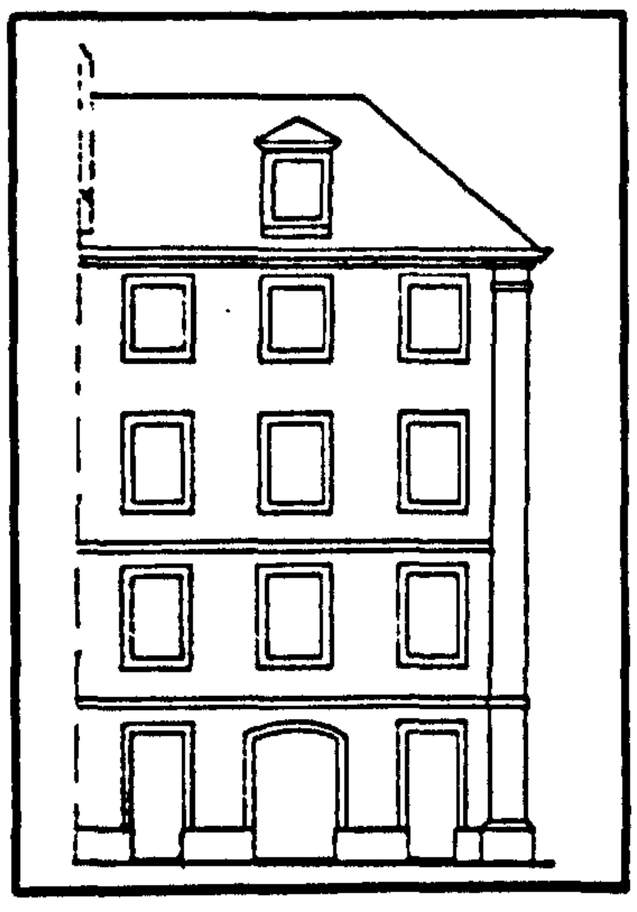


Fig.129-Variation of type 5 façade-2

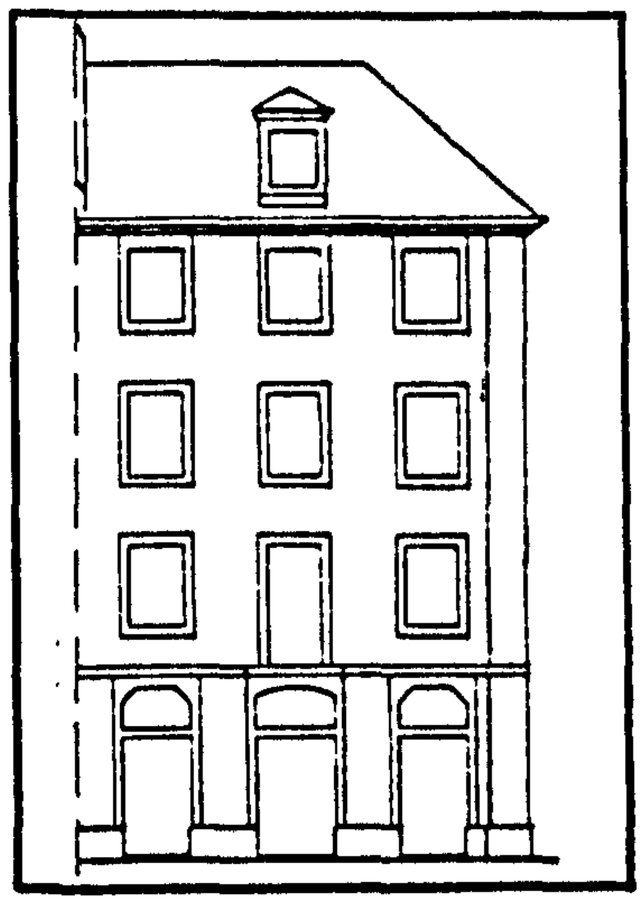


Fig.130-Variation of type 5 façade-3

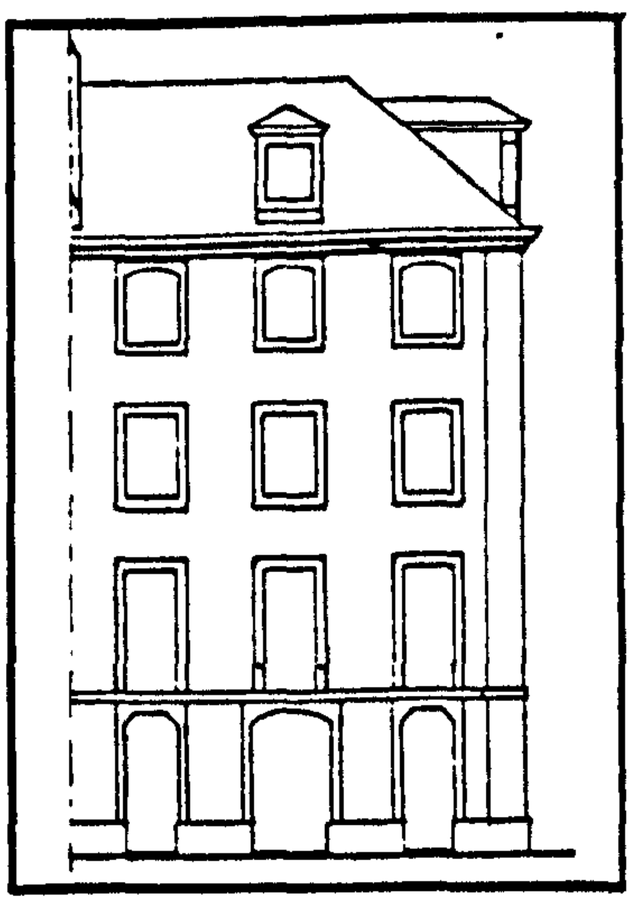


Fig.131-Variation of type 5 façade-4

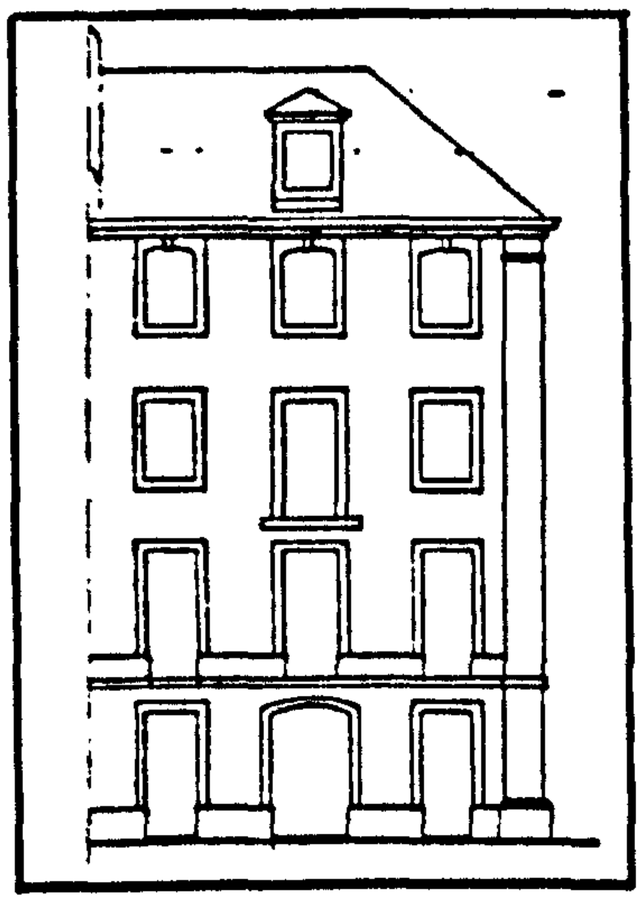


Fig.132-Variation of type 5 façade-5

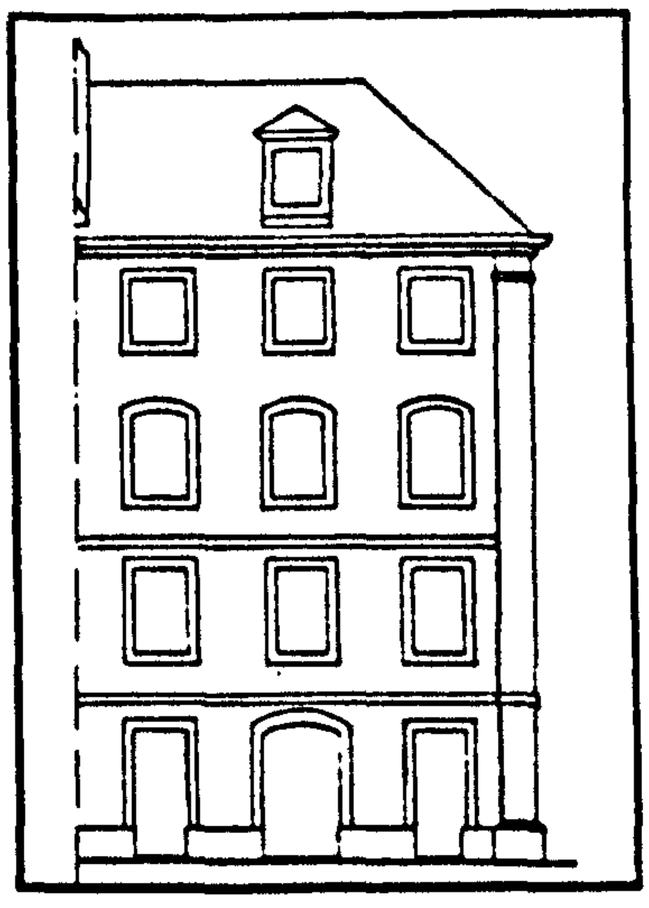


Fig.133-Variation of type 5 façade-6

Type 6 - Hybrid alleys of little importance, (*Santa Justa*, *Vitória* and *São Nicolau* Streets), (see Fig. 134, 135 and 136).

The composition shows no rigid discipline, since the alleys in question are defined by the narrow ends of the blocks, the composition varying in accordance with the streets which cross the alleys.

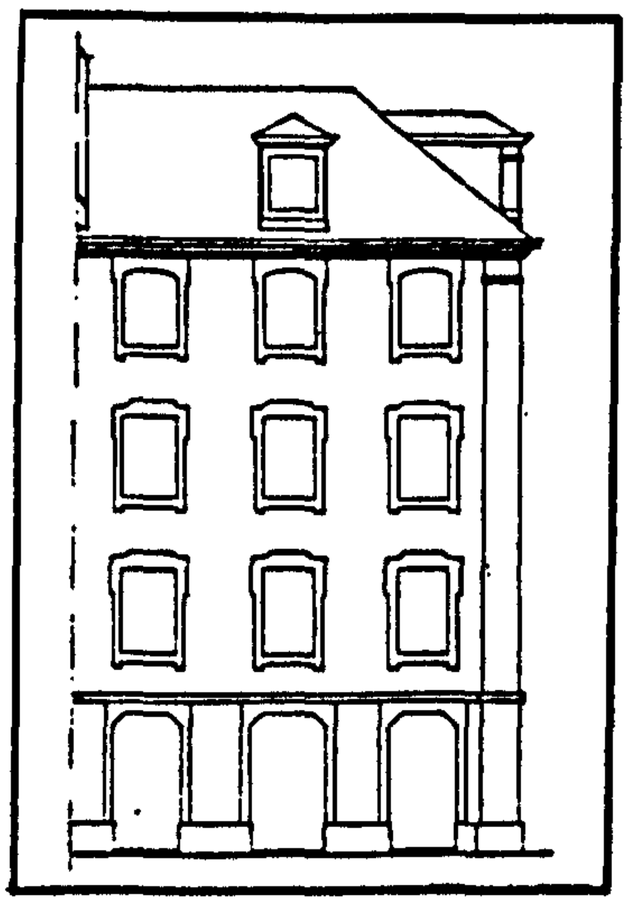


Fig.134-Variation of type 6 façade-1

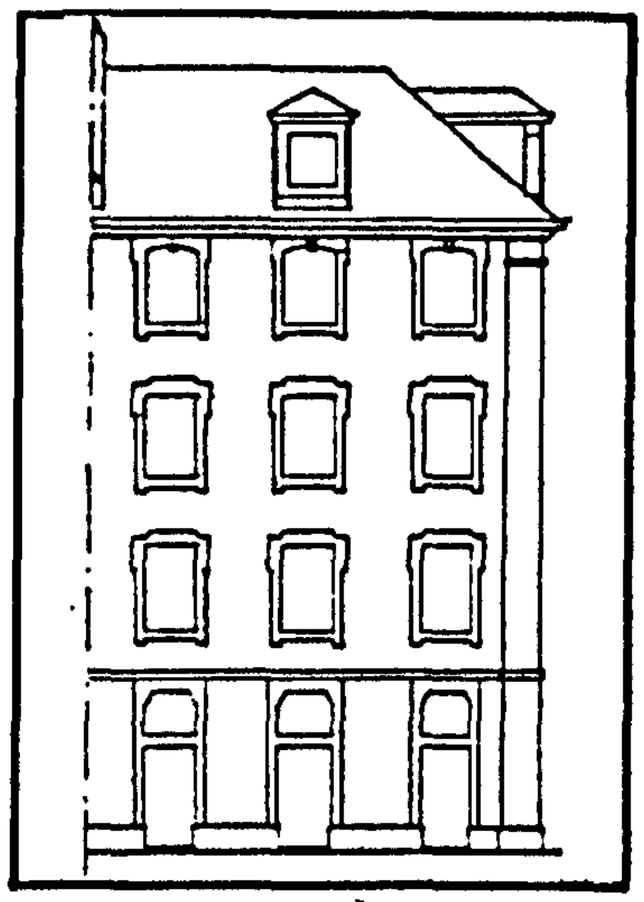


Fig.135-Variation of type 6 façade-2

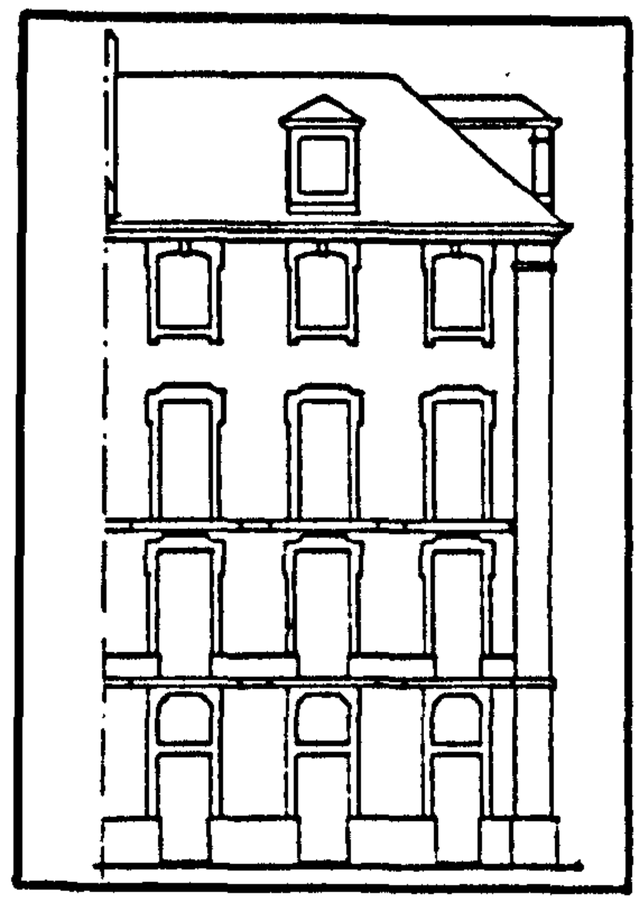


Fig.136-Variation of type 6 façade-3

These six types with their minor variations appear to be consistent without any significant deviation, for all of the Pombaline buildings. This suggests that the exterior design of buildings was rigidly imposed throughout the whole construction period (1760-1830), fully complying with the hierarchy of streets and squares. On the other hand, it would appear that the interiors of the buildings were in part constructed to each owner´s requirements over the full construction period. Therefore in this case it is possible to identify substantial variations in style, decoration and planform and hence to define possible evolutionary sequences which may have arisen in the form of interior construction and finish.

Therefore details of the interiors of the 304 buildings selected for this study were carefully recorded.

The next two sections give a general overview of the interior design and plan of these buildings, and of the form of decoration present within them.

III.2 The interior of the buildings

III.2.1. Individual features at different levels.

The interior of the rentable building, like its exterior, is quite simple, (see Fig.137) with finishings extremely austere.

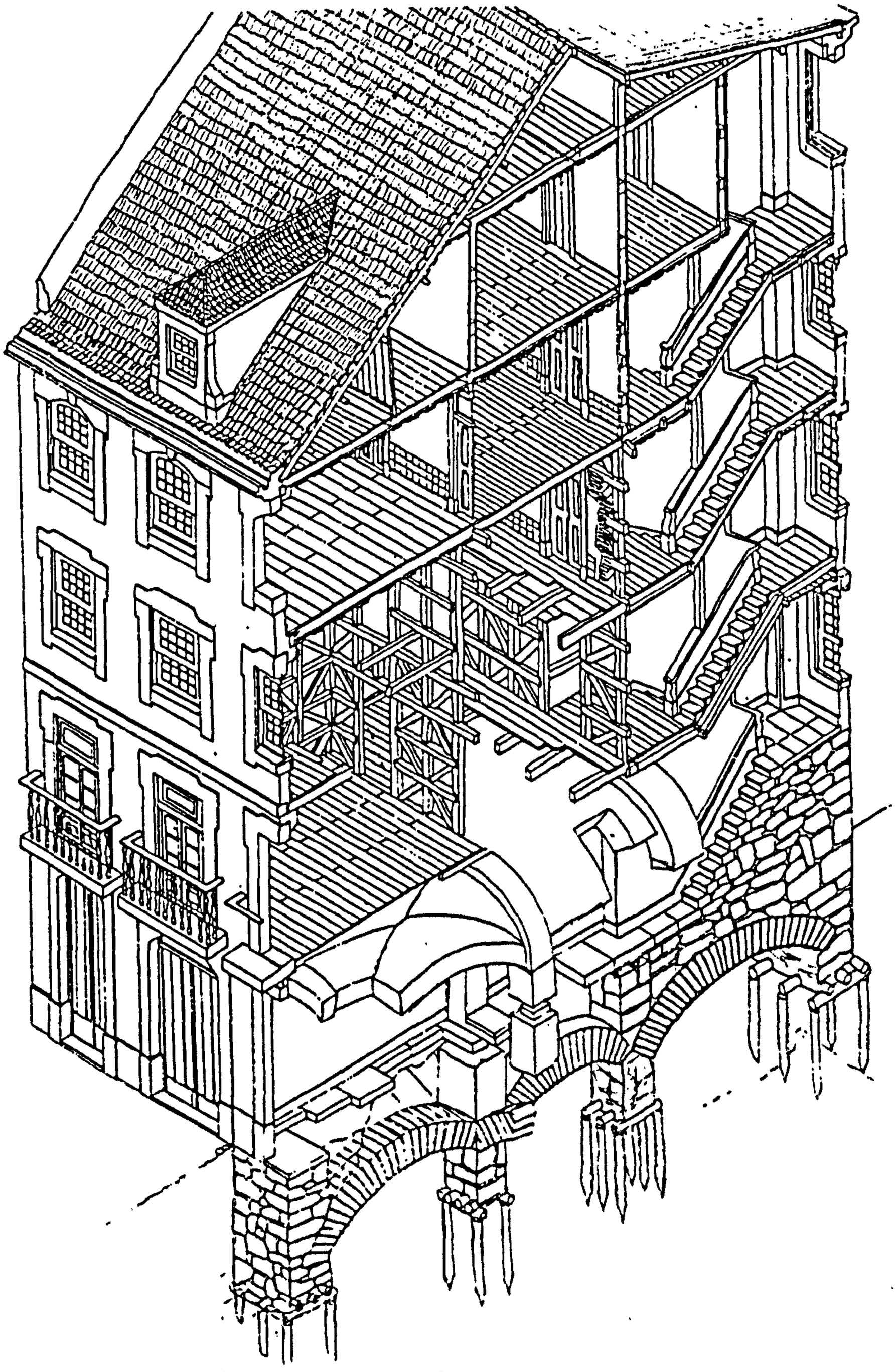


Fig.137-An isometric drawing of number 110, S. Julião Street, some lath and plaster omitted to show the *gaiola* (cage).

The interior at ground floor level which is occupied by shops is basically a succession of spaces paved with heavy square flagstones, that may be covered by quadripartite vaults, (used in the past as stables on the transverse streets, see Fig.138) or arches and beams (see Fig.139) or just beams (see Fig.140), supported by thick walls and pillars.

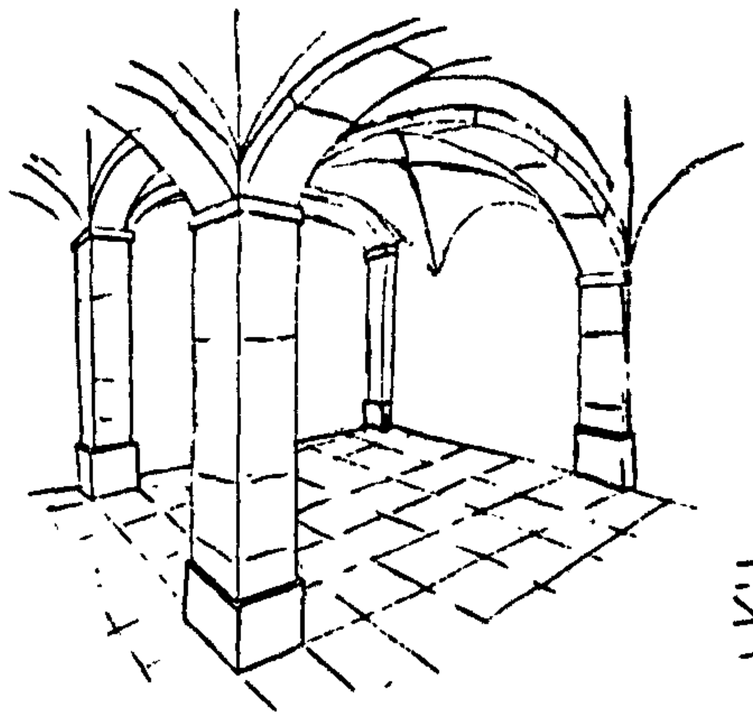


Fig.138-Ground floor covered with vaults

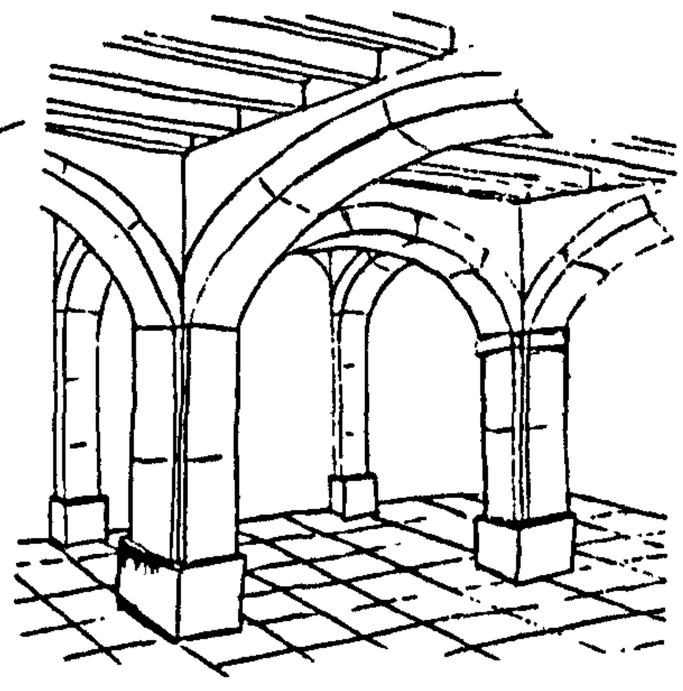


Fig.139-Ground floor covered with arches and beams

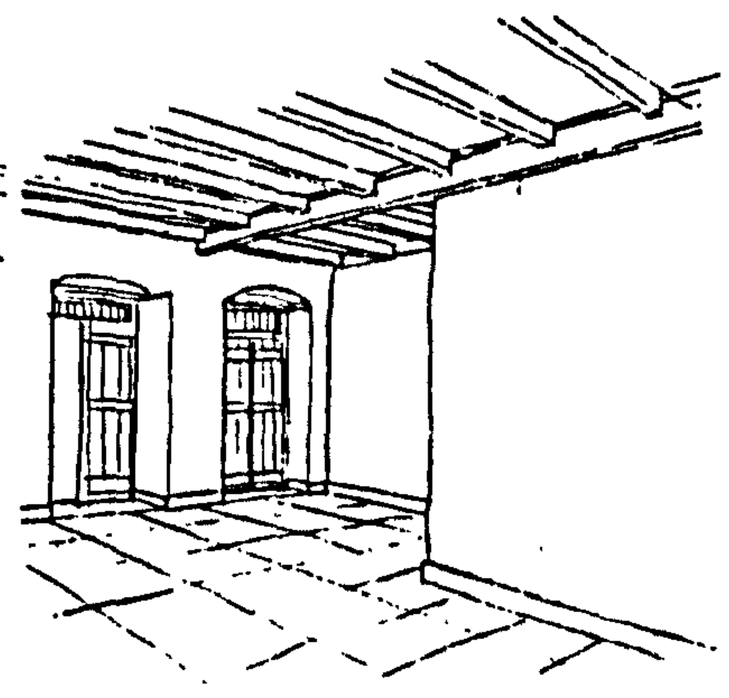


Fig.140-Ground floor covered with beams

Access to the upper levels, (exclusively residential) is through an entrance, normally placed in the centre of the façade, which leads into a narrow, dark hallway (Fig.141). Normally behind the entrance door existed a cupboard that opened to allow the area to be used as a small shop, (Fig.142).

The first flight of stairs was usually of stone.

Fig.141-The hallway

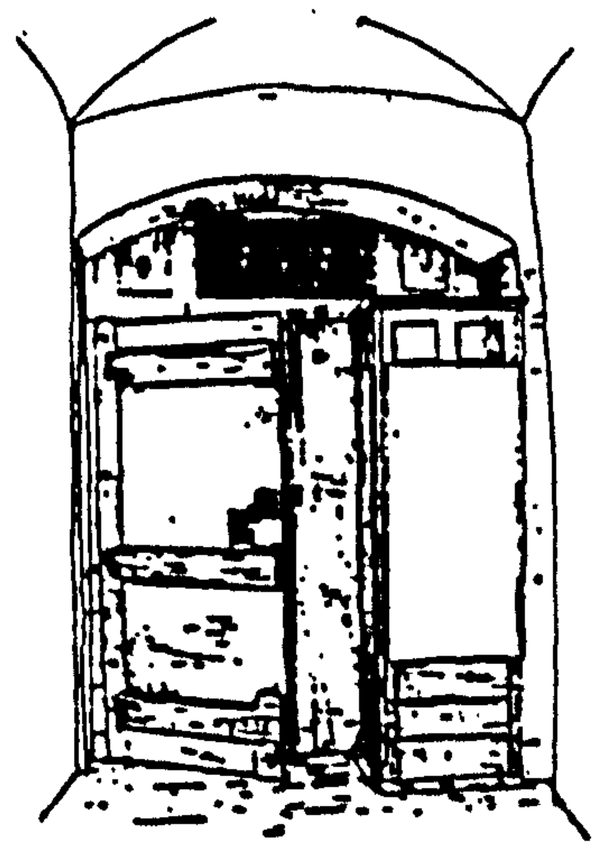


Fig.142-The entrance (inside).

The stairs, normally positioned in the middle of the building, are narrow with two flights separated by a half-landing. There are different types of stairs, the most simple ones climb alongside a wall, or alongside a "solid" balustrade which continues through the height of the staircase and forms a wall, but with breaks above hand rail height and below the soffit of the next landing. Others are adjacent to an open space (see Fig.143, 144, 145 and 146). The balustrades can be smooth-finished wood or modulated iron work, (Fig.147 and 148). They can also be decorated with tile dados (see Fig.149).

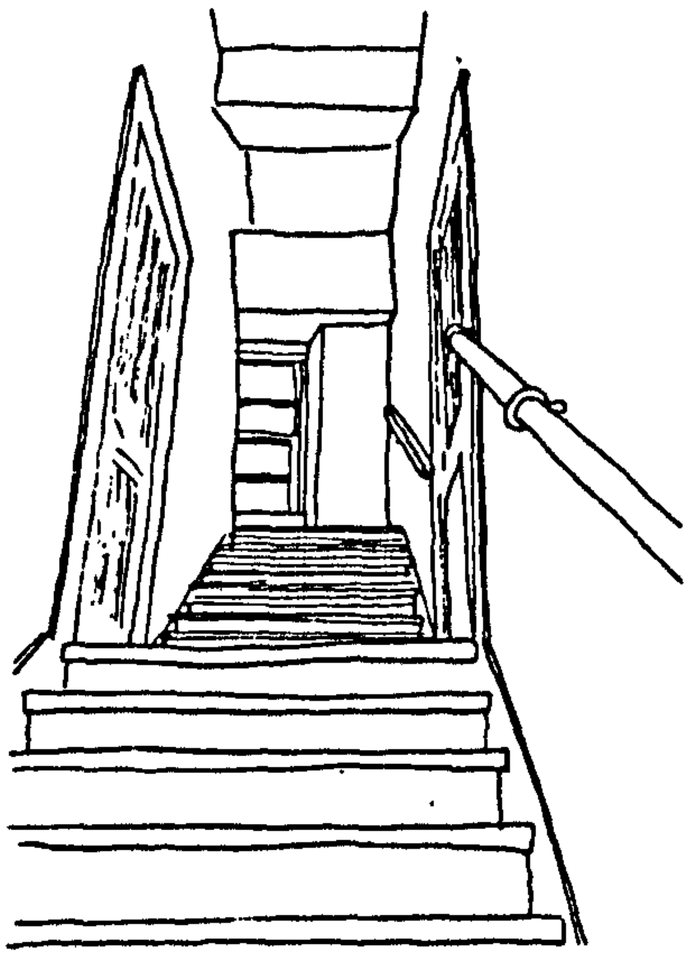


Fig.143-A straight stair

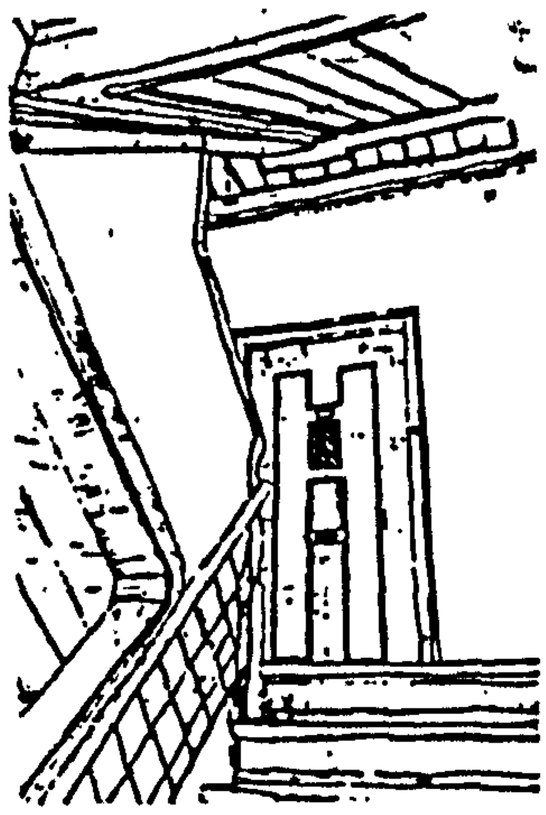


Fig.144-Stair that climbs alongside "solid" balustrade.

Fig.145-Stair that climbs alongside an interior space

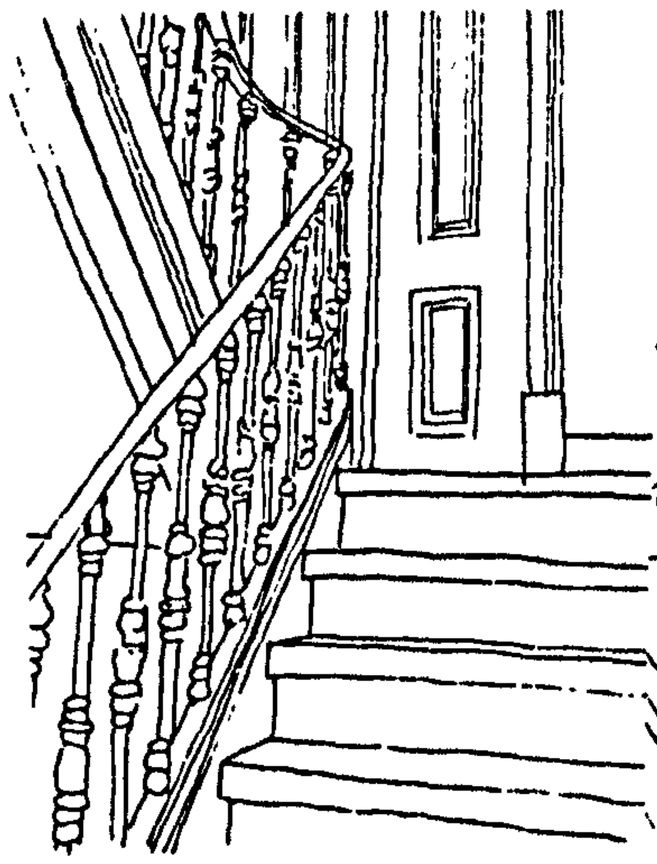


Fig.146-Stair that climbs alongside an interior space with iron balustrade

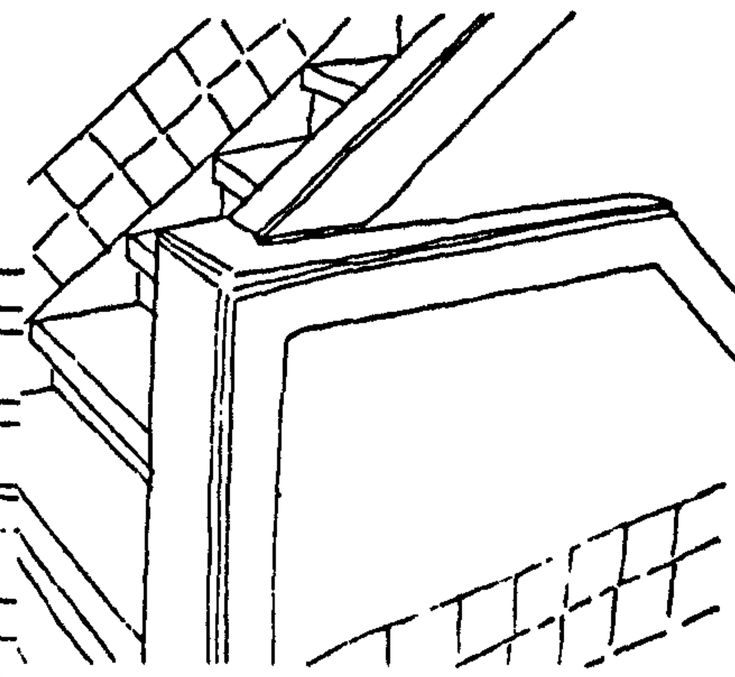


Fig.147-Wood balustrade

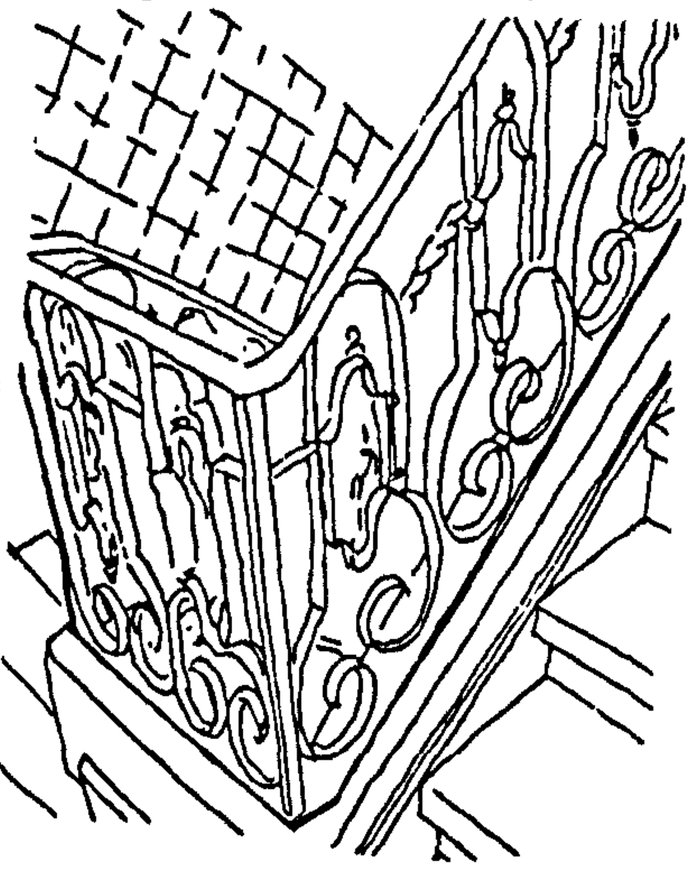


Fig.148-Iron balustrade

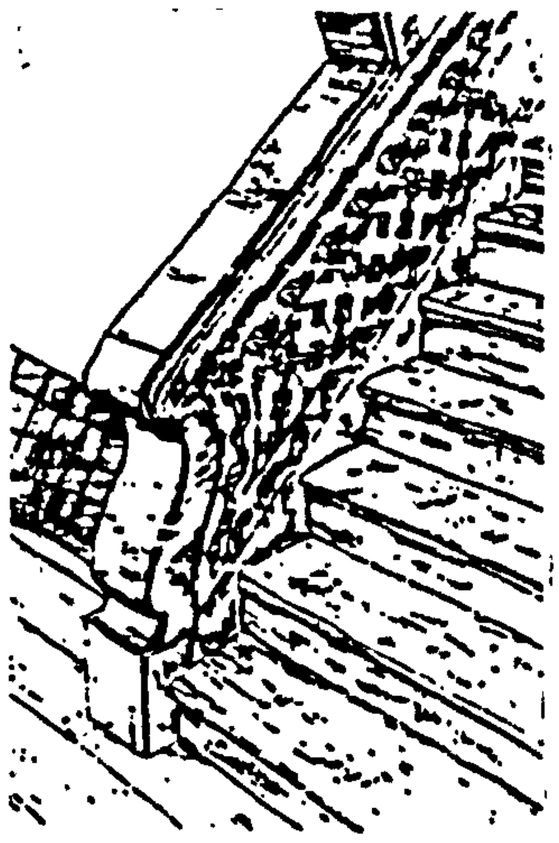


Fig.149-Decoration with tile dados

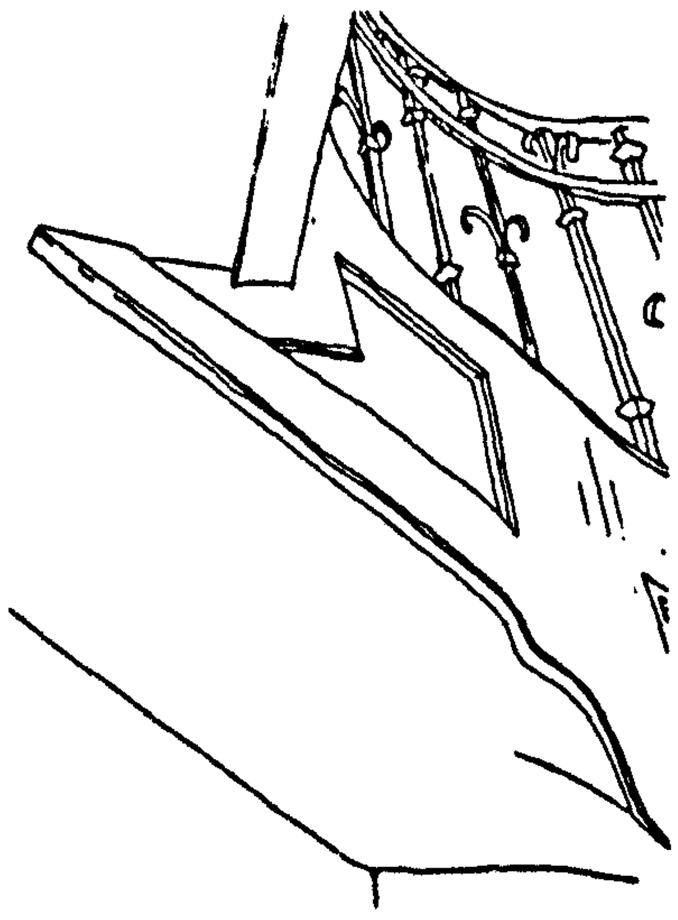


Fig.150-Stair with three flights

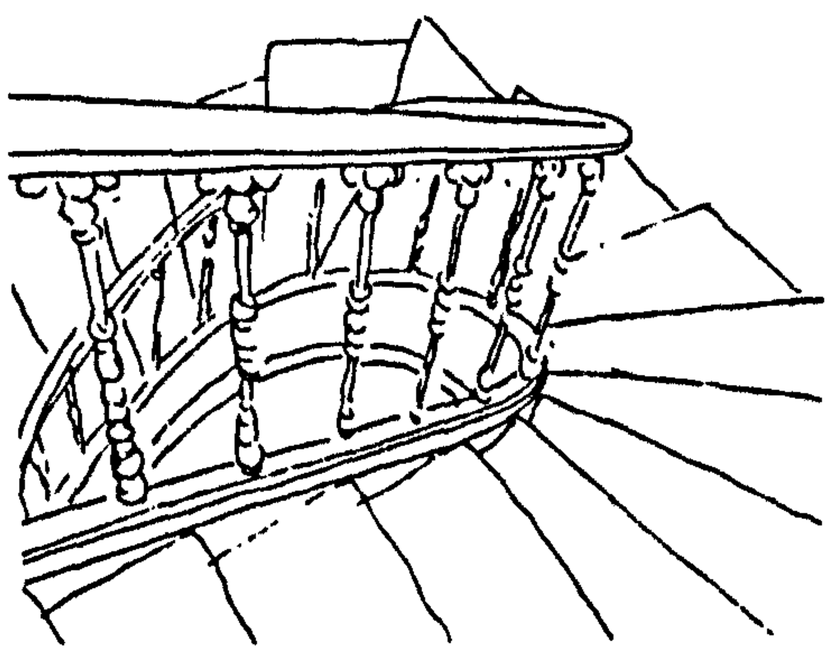


Fig.151-Helical stair

Some buildings have elaborate stairs without half-landings, (Fig.150 and 151). The first floor landing serves two flats, (each flat with one or two entrances). This is a common arrangement in Lisbon and the flats are normally designated *esquerdo/direito*, (left/right) and in most cases are symmetrical, (see Fig.152, 153 and 154).

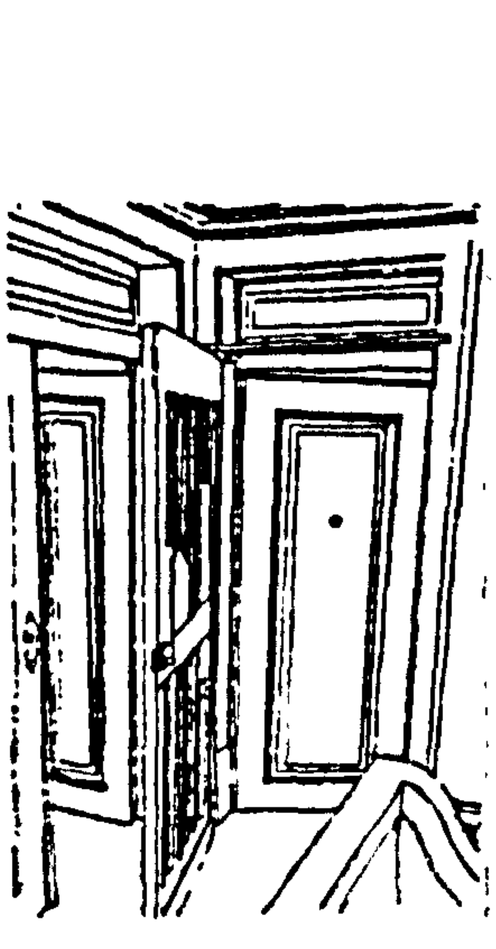


Fig.152-The entrance-1

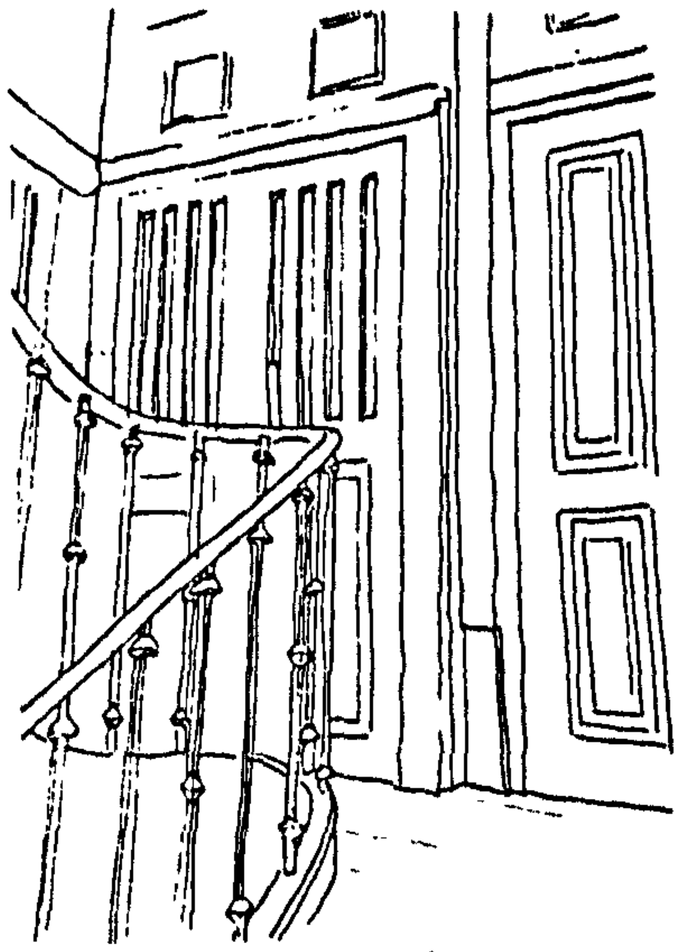


Fig.153-The entrance-2

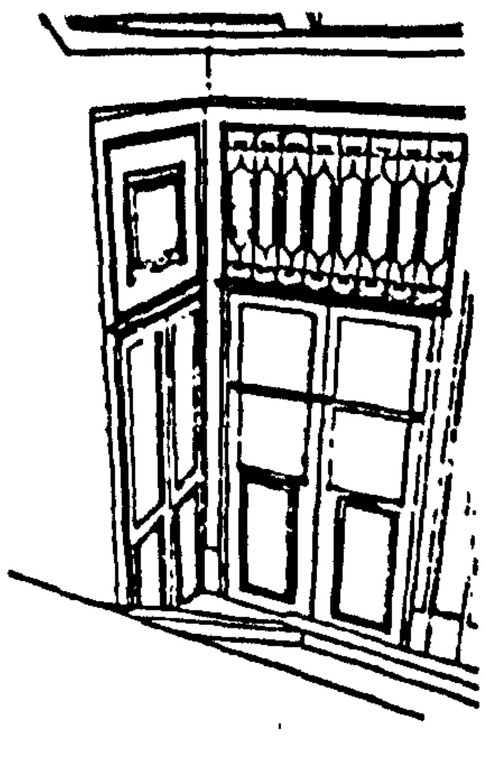


Fig.154-The entrance-3

The interior arrangement of the flats is very basic. The most important rooms, (dining and living rooms) always face the street, so they are well-lit and airy, (Fig.156). They can also be decorated with tile dados. The kitchens, on the other hand are very simple without decoration, (see Fig.155), and always have windows facing the interior space of the block, the "*alfugere*" or inner courtyard .

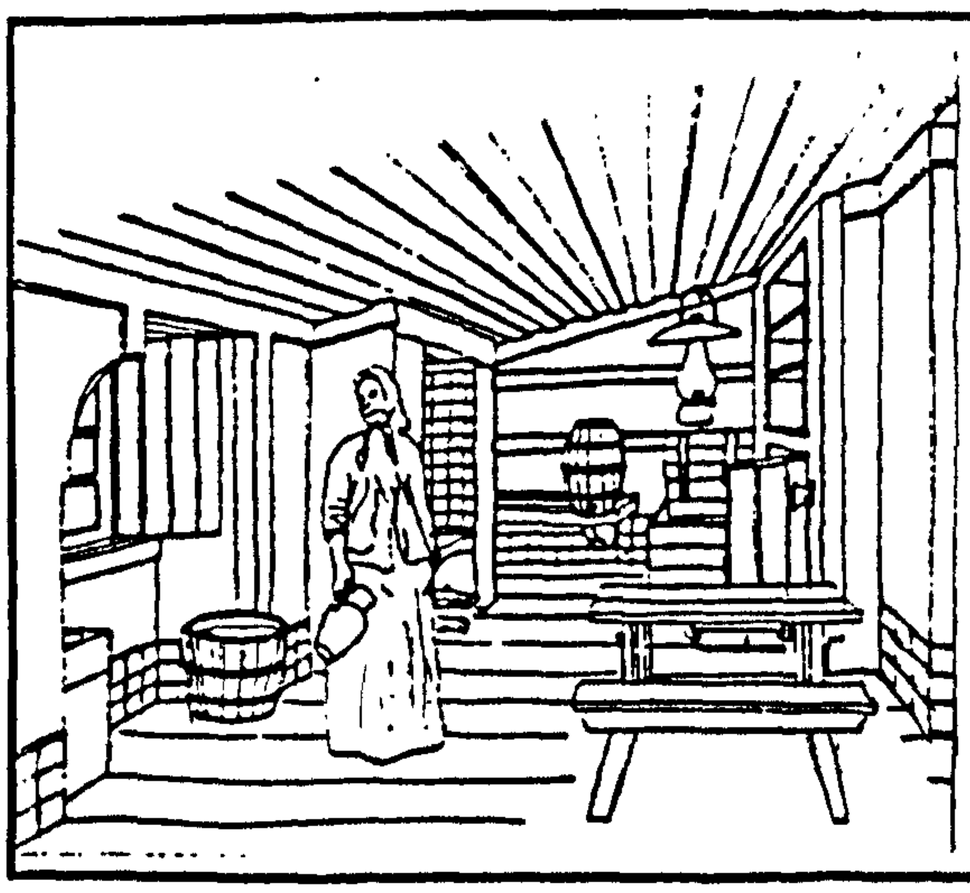


Fig.155-The kitchen

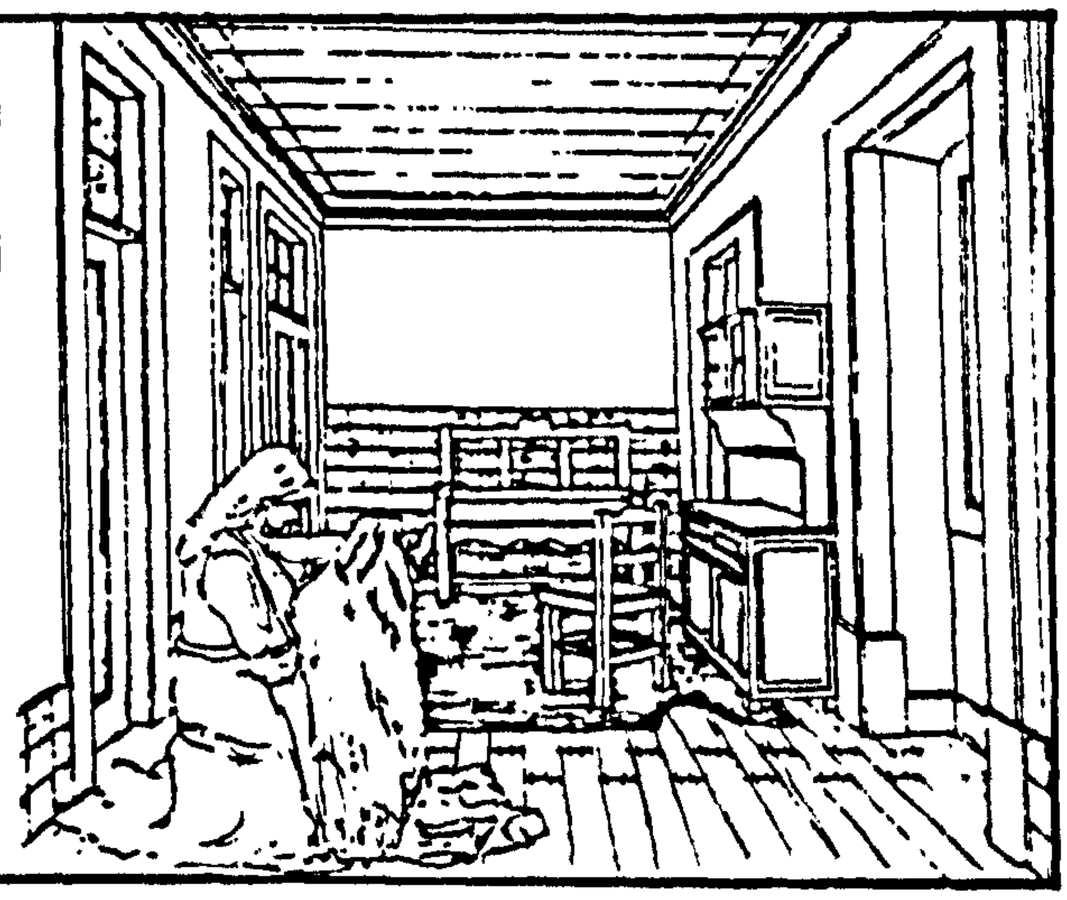


Fig.156-Dining and living room

There were no separate toilets, a small basin used for the purpose always being situated in one of the kitchen corners, (see Fig.157, 158 and 159).

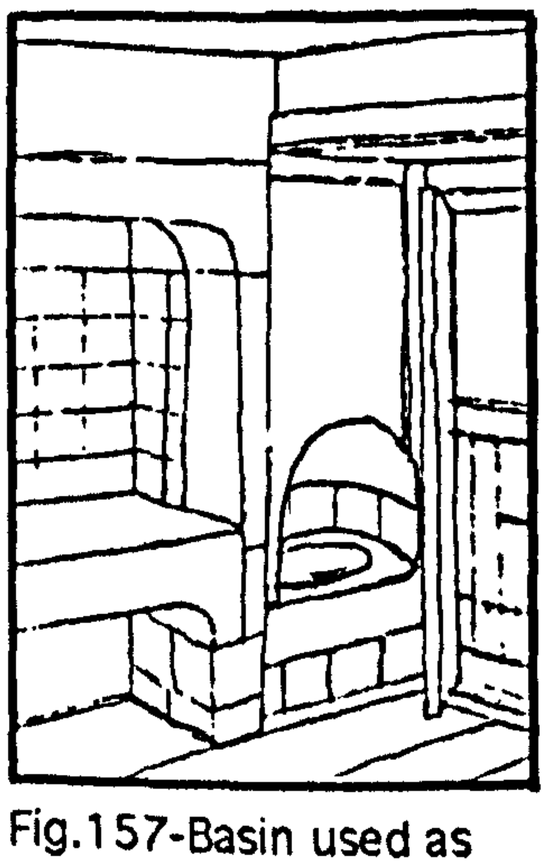


Fig.157-Basin used as toilet-1.

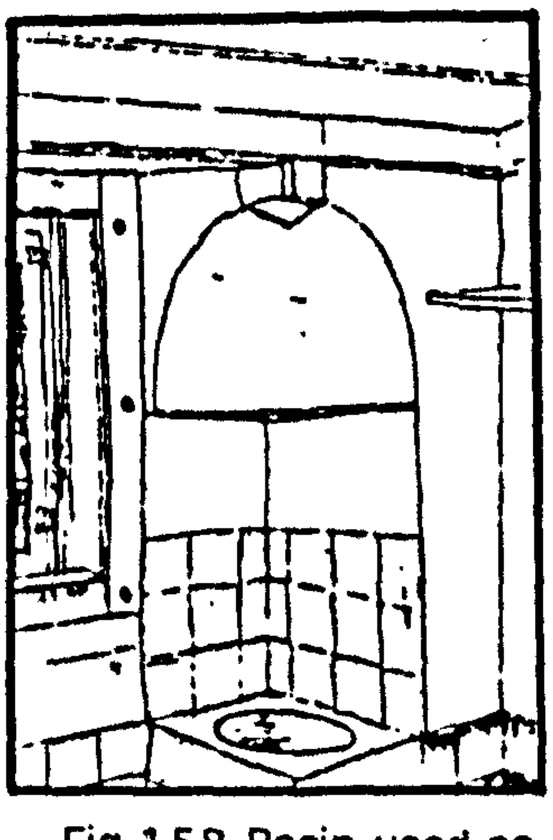


Fig.158-Basin used as toilet-2.

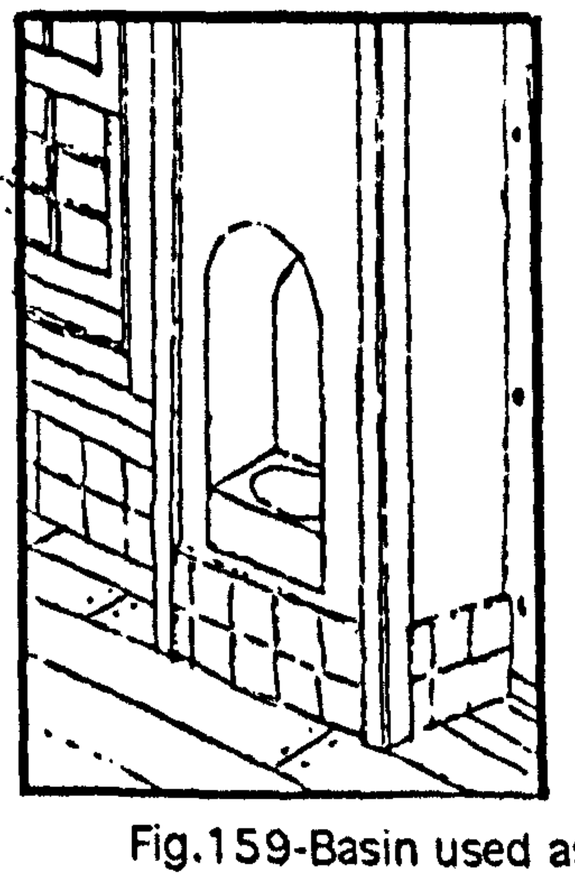


Fig.159-Basin used as toilet-3.

Cupboards, when present, are crude and the tiling on the walls continues behind them, (see Fig.160, 161 and 162).

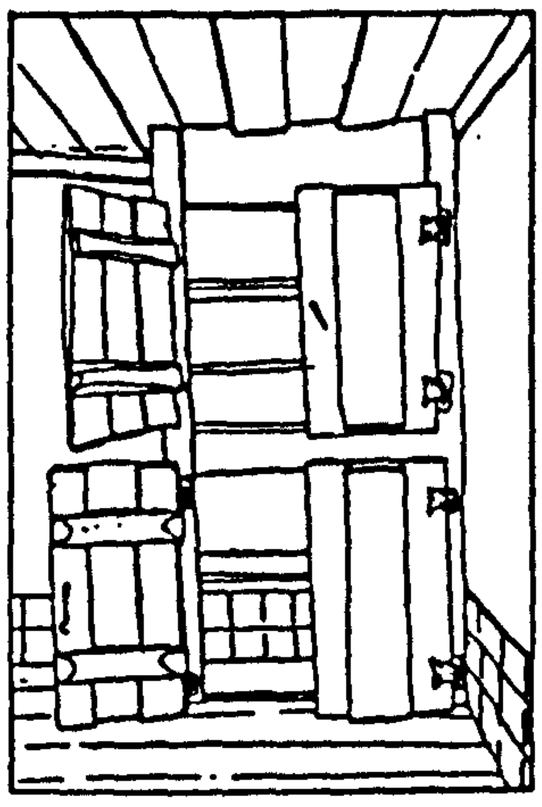


Fig.160-Type of cupboard-1

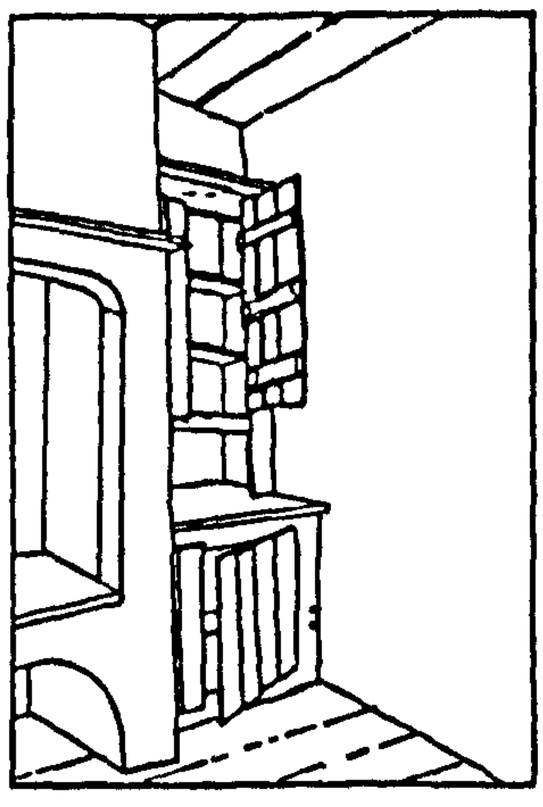


Fig.161-Type of cupboard-2

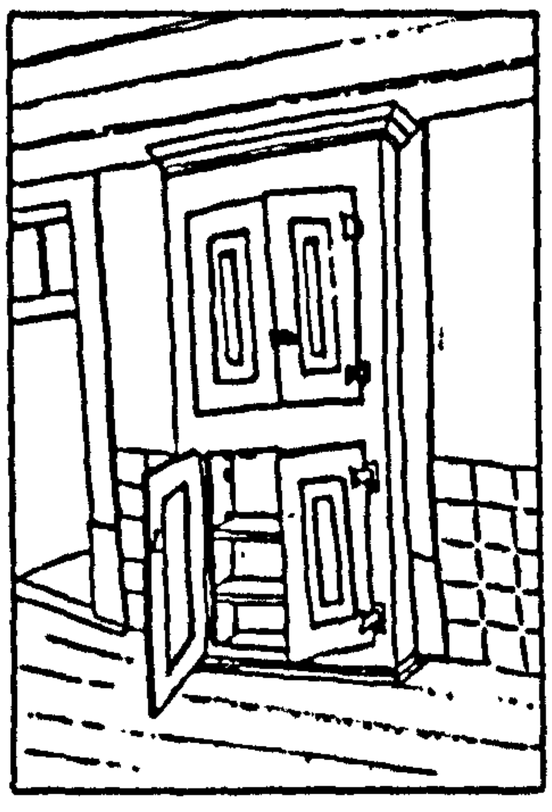


Fig.162-Type of cupboard-3

The kitchens are always dominated by an enormous fireplace, with walls on either side and a hearth stone placed between them, (see Fig.163, 164 and 165). In some cases the interiors of fireplaces were covered with tiles. The location of the fire place is always near the façade but varies from one flat to another (see Fig.166). In some buildings there are separate flues for each flat, (see Fig.167).

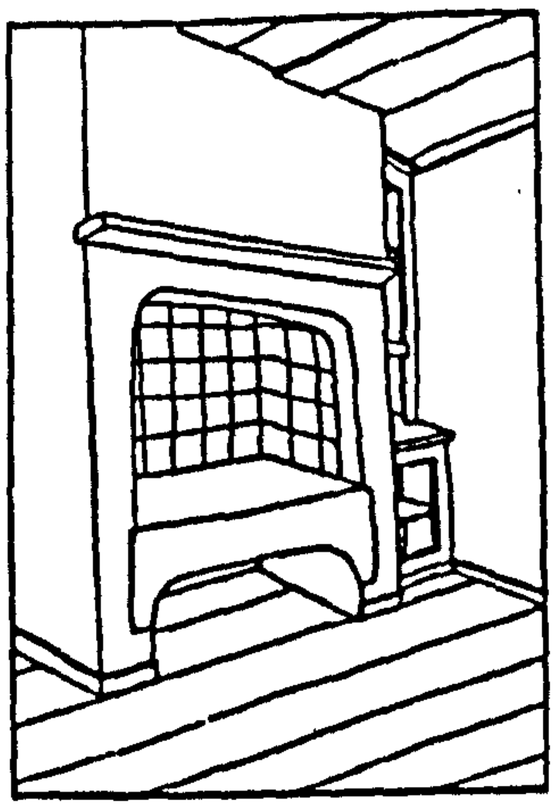


Fig.163-Type of fireplace-1

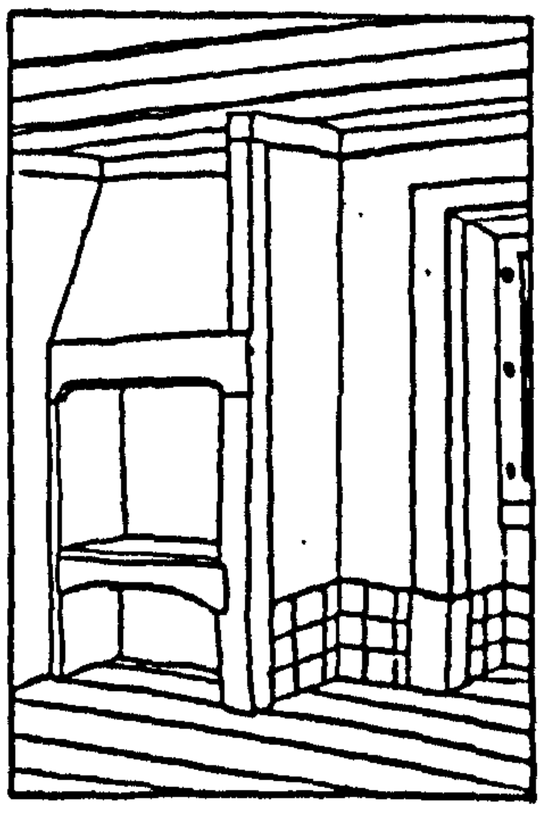


Fig.164-Type of fireplace-2

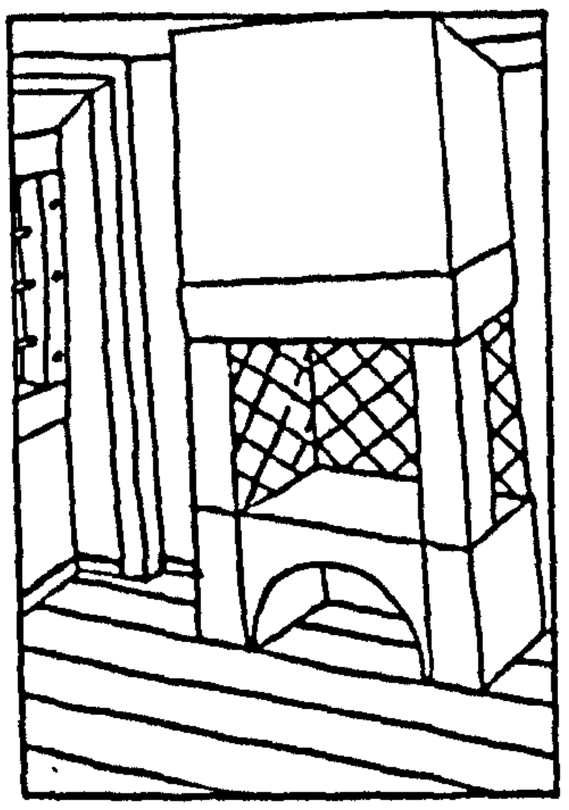


Fig.165-Type of fireplace-3

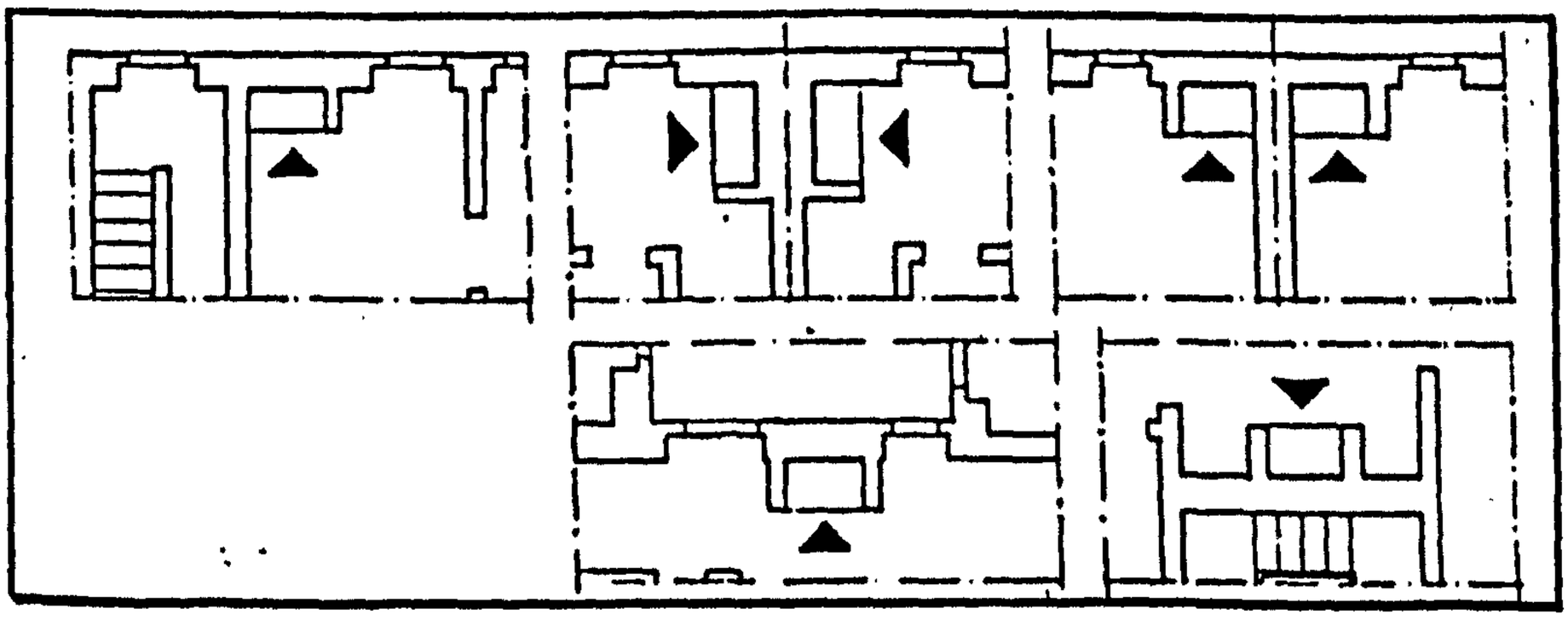


Fig.166-Different positions of fireplaces

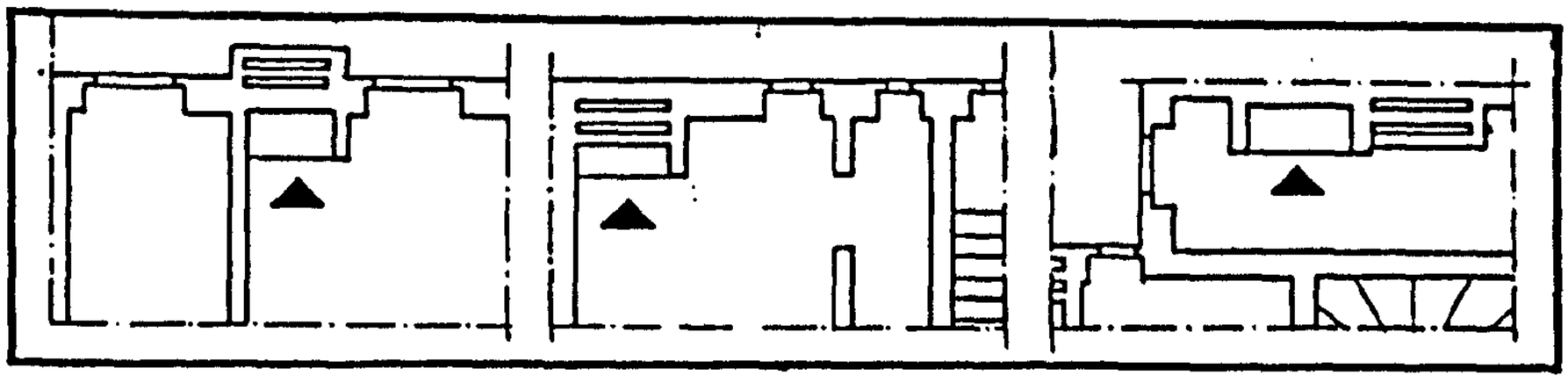


Fig.167-The flues on different floors

Between the front rooms and the kitchens, always there are numerous inner rooms without direct light or ventilation, positioned in a rigidly modulated way. These compartments have no independent access via corridors, (see Fig.168). Instead there are numerous interconnecting doors,(see Fig.169), which result in much space being needed for circulation through the inner rooms.

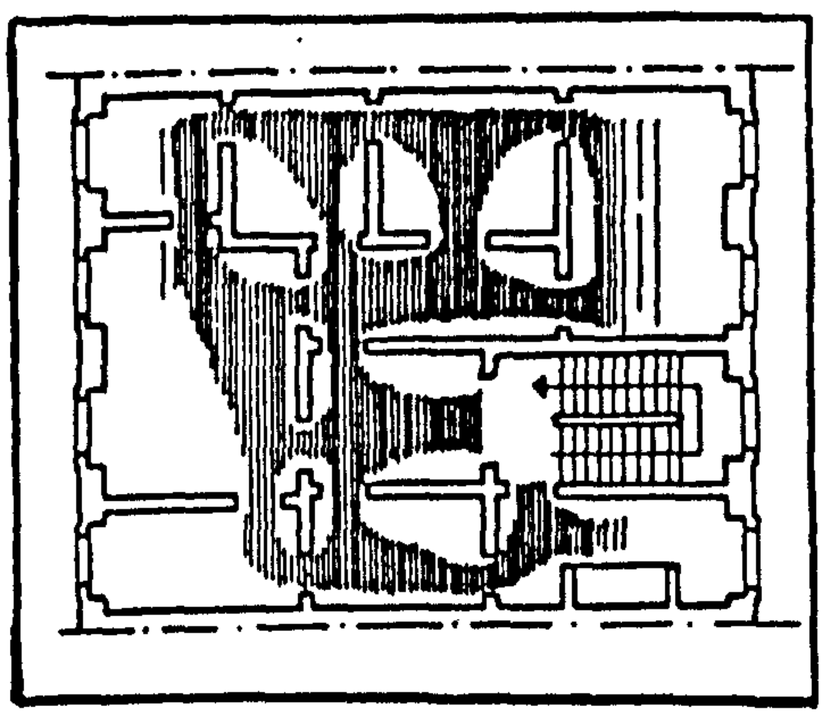


Fig.168-Circulation space through the rooms (Shown hatched)

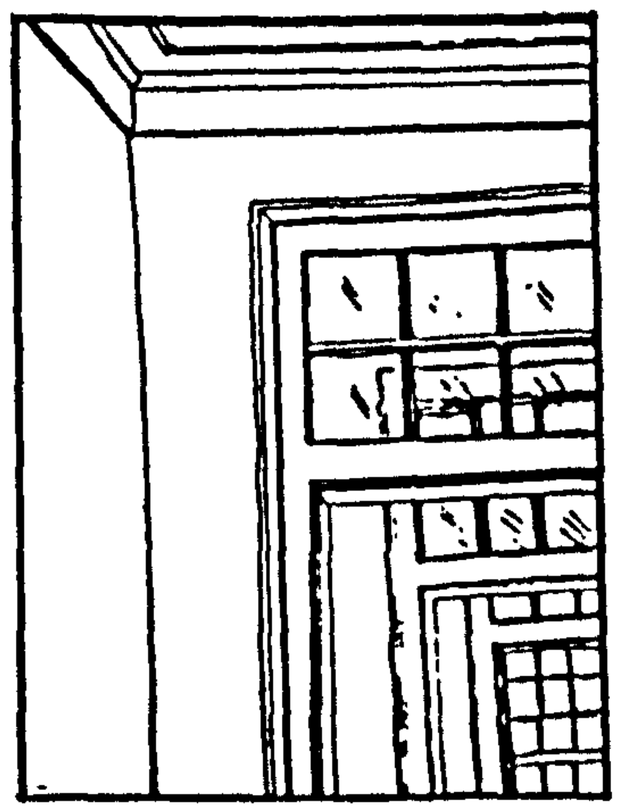


Fig.169-Interconnecting doors

Because the lower flats have excessively high ceilings, especially at first floor level, the doors have large fanlights which allow some light to enter the inner rooms (Fig.169).

Interior decoration when present is limited to small, tiled dados, (Fig.170). The floors are always made of soft pine boards and the ceilings are of unpainted wooden boards with cover strips at the joints (Fig.171), or just wood laths covered with plaster.

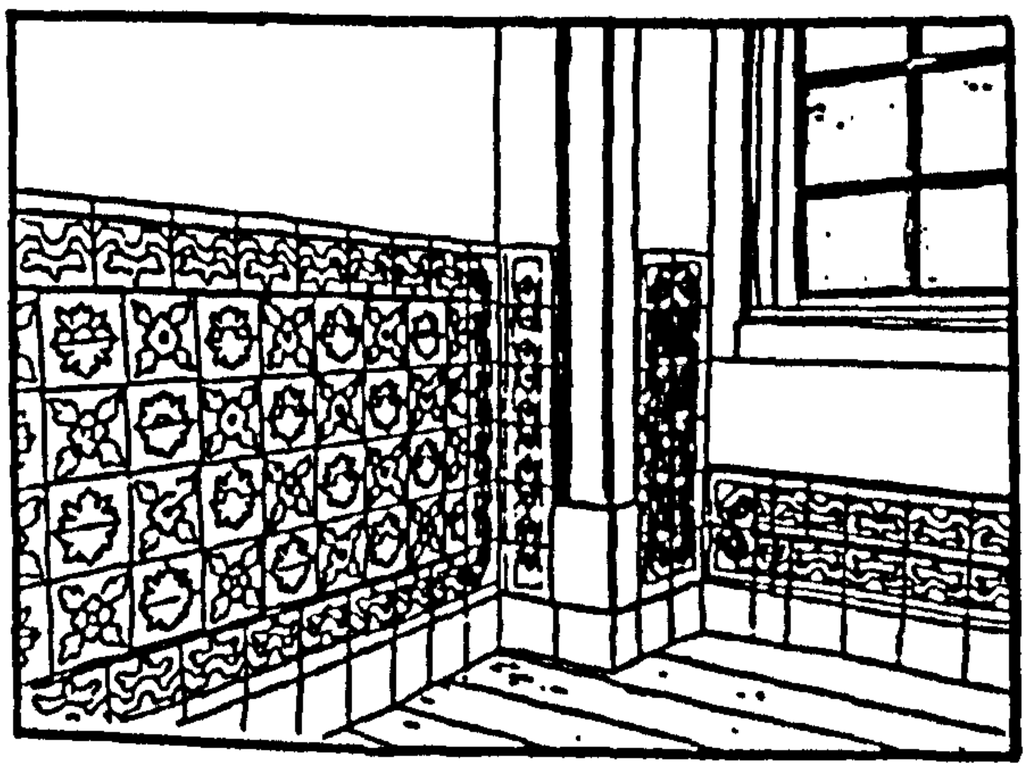


Fig.170-The tiled dados

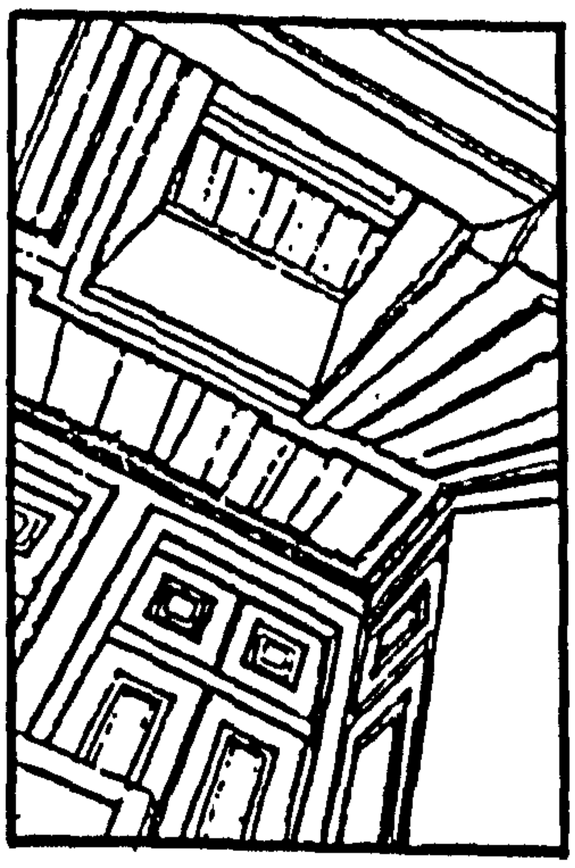


Fig.171-The ceilings

The front doors are panelled, the interior doors are simpler. Originally the windows were the vertical slide sash type , (Fig.172).

On the upper levels the ceilings become lower, (Fig.173, 174, 175, 176 and 177), with finishings of poor quality, taking on a rustic style especially in the attics.

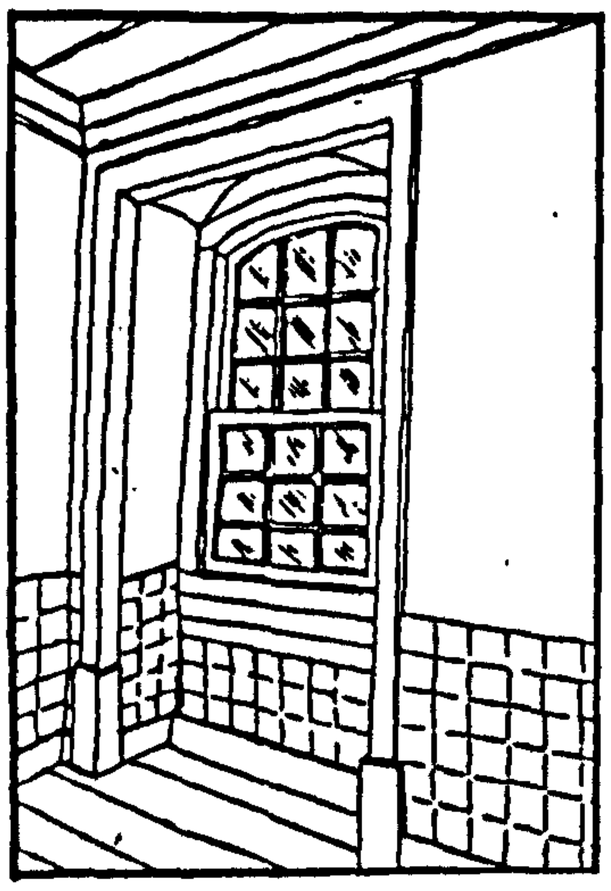


Fig.172-A sash window

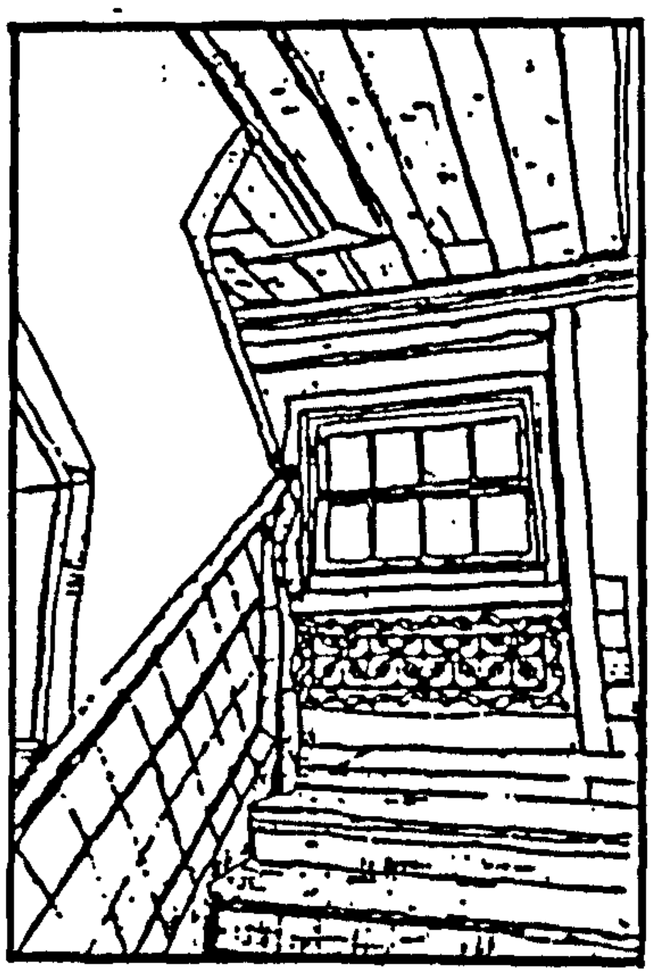
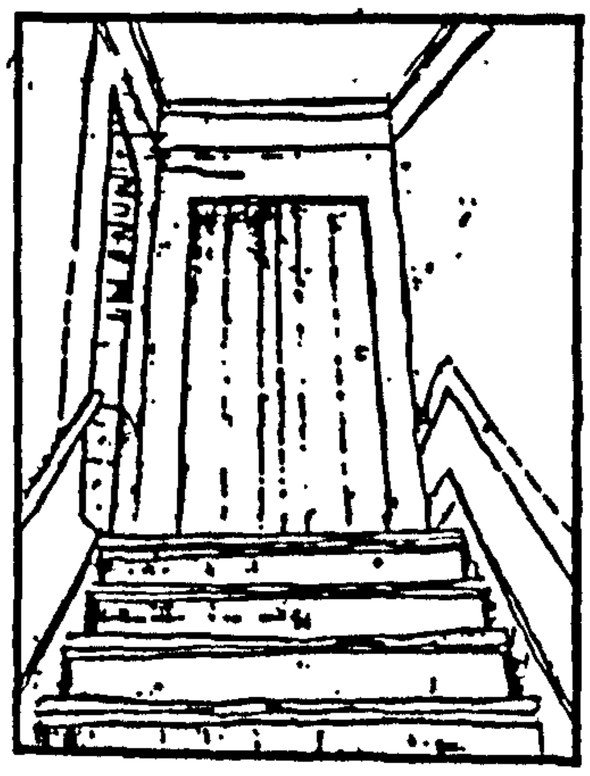


Fig.173-On the top landing of the stairs, the windows are lower



174-On the top floor the entrance is immediately at the top of the stairs

There, the living conditions are poorer due to the small number of windows and the irregular ceilings.

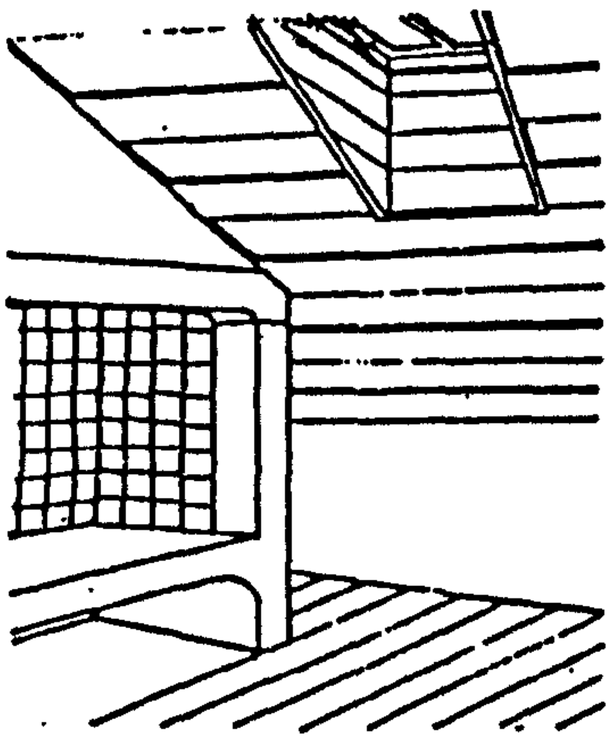


Fig.175-A rooflight over a kitchen

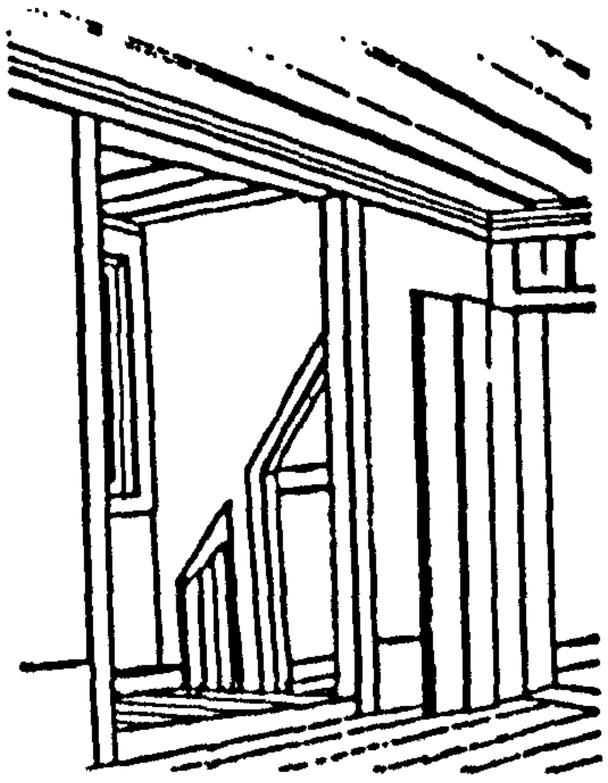


Fig.176-The entrance to an attic flat.

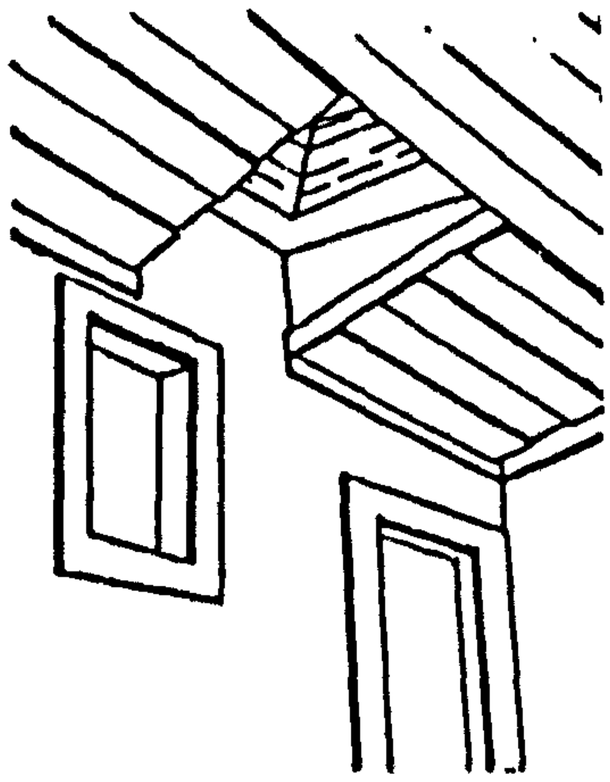


Fig.177-A room in an attic flat.

Although there is considerable variability in the features discussed in this section, the principal features and their variations have been presented.

III.2.2. Details of the plans of some of the rentable buildings.

The Pombaline rentable buildings never emerged as isolated units but were always grouped into blocks (mainly rectangular), which besides reinforcing the composition effect and making better use of the land, also gave them greater structural stability. Today many buildings have been altered, (in height, for example), diluting the unity of the design.

Drawings of a complete block which illustrate typical interior structures in relation to the external façade for these buildings are presented in the next pages (Fig.178, 179, 180, 181, 182 and 183) and a survey of the first floor of further blocks is included as Appendix number 5. In the original buildings the plan layout of the first, second and third floors was usually the same or similar.

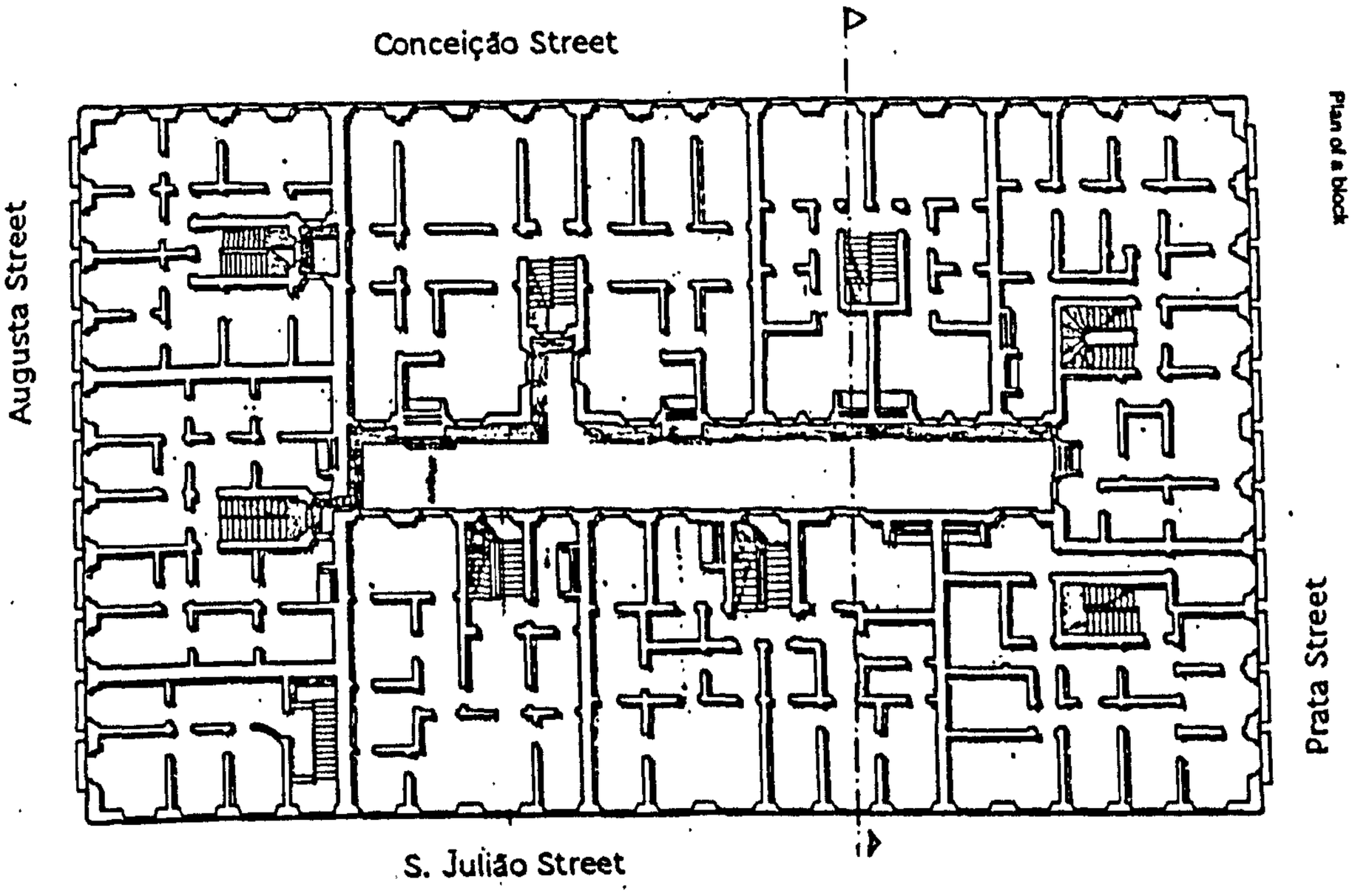


Fig.178-Plan of a complete block.
Block: Conceição, S. Julião, Prata and Augusta Streets

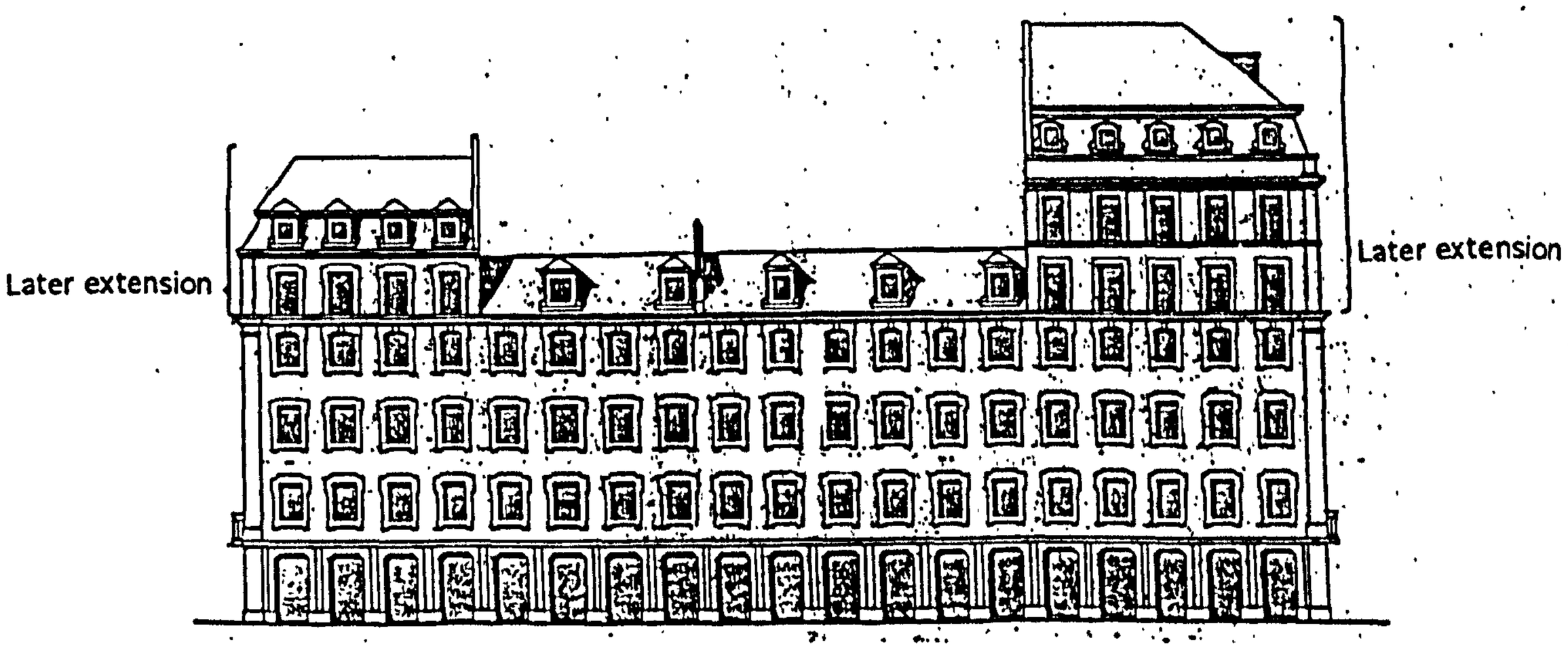


Fig.179-Elevation of the block, S. *Julião* Street
Note:This and the following elevations are shown with the ground, first, second and third floors as originally built but with later extensions at fourth and higher floor levels.

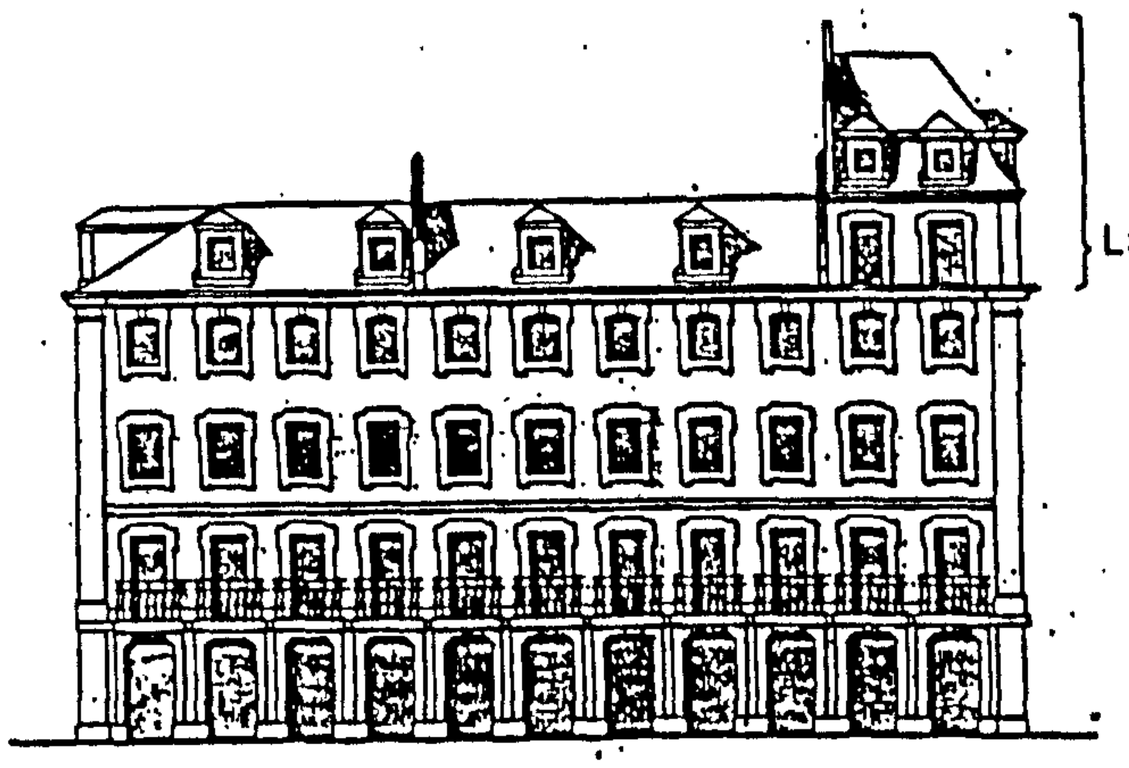


Fig.180-Elevation of the block, *Augusta* Street.

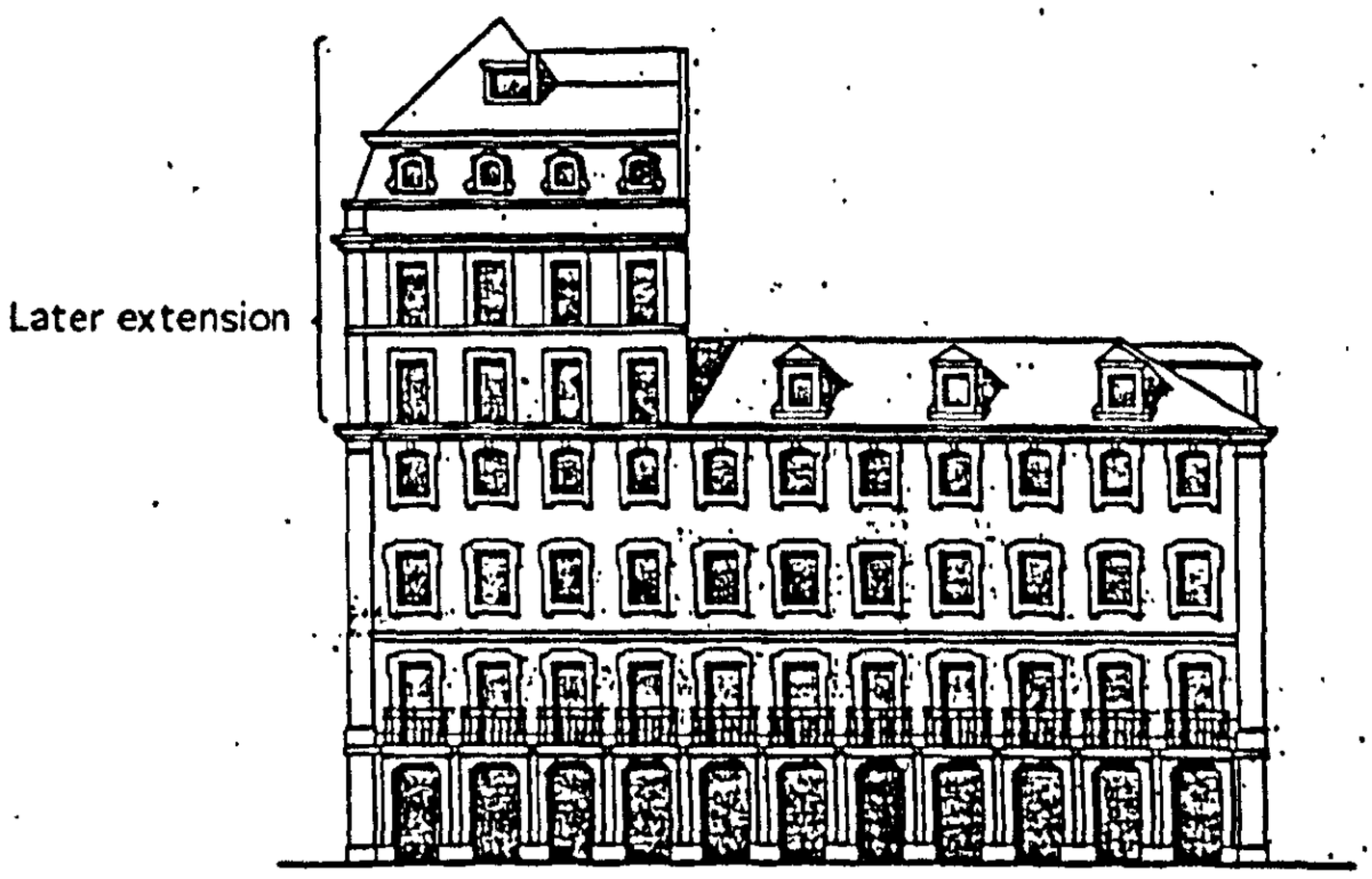


Fig.181-Elevation of the block, *Prata* Street.

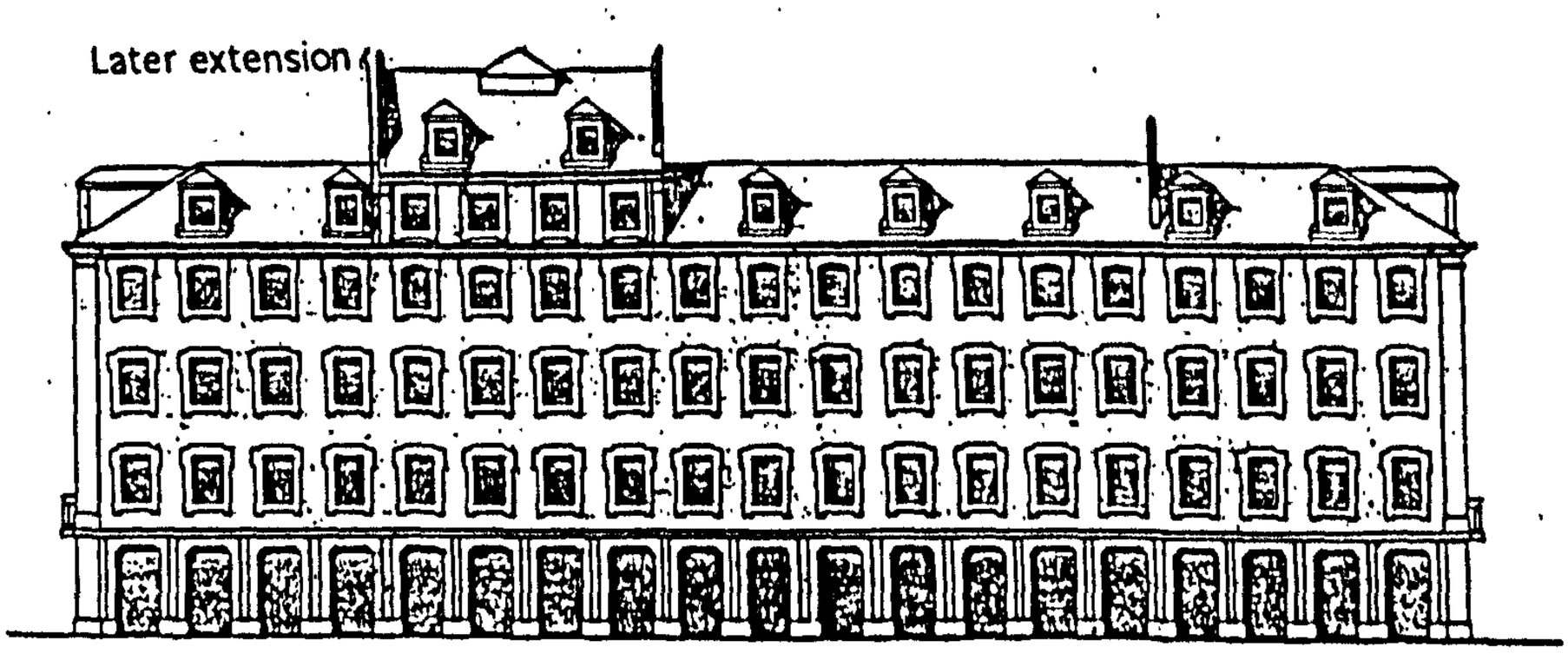


Fig.182-Elevation of the block, *Conceição* Street.

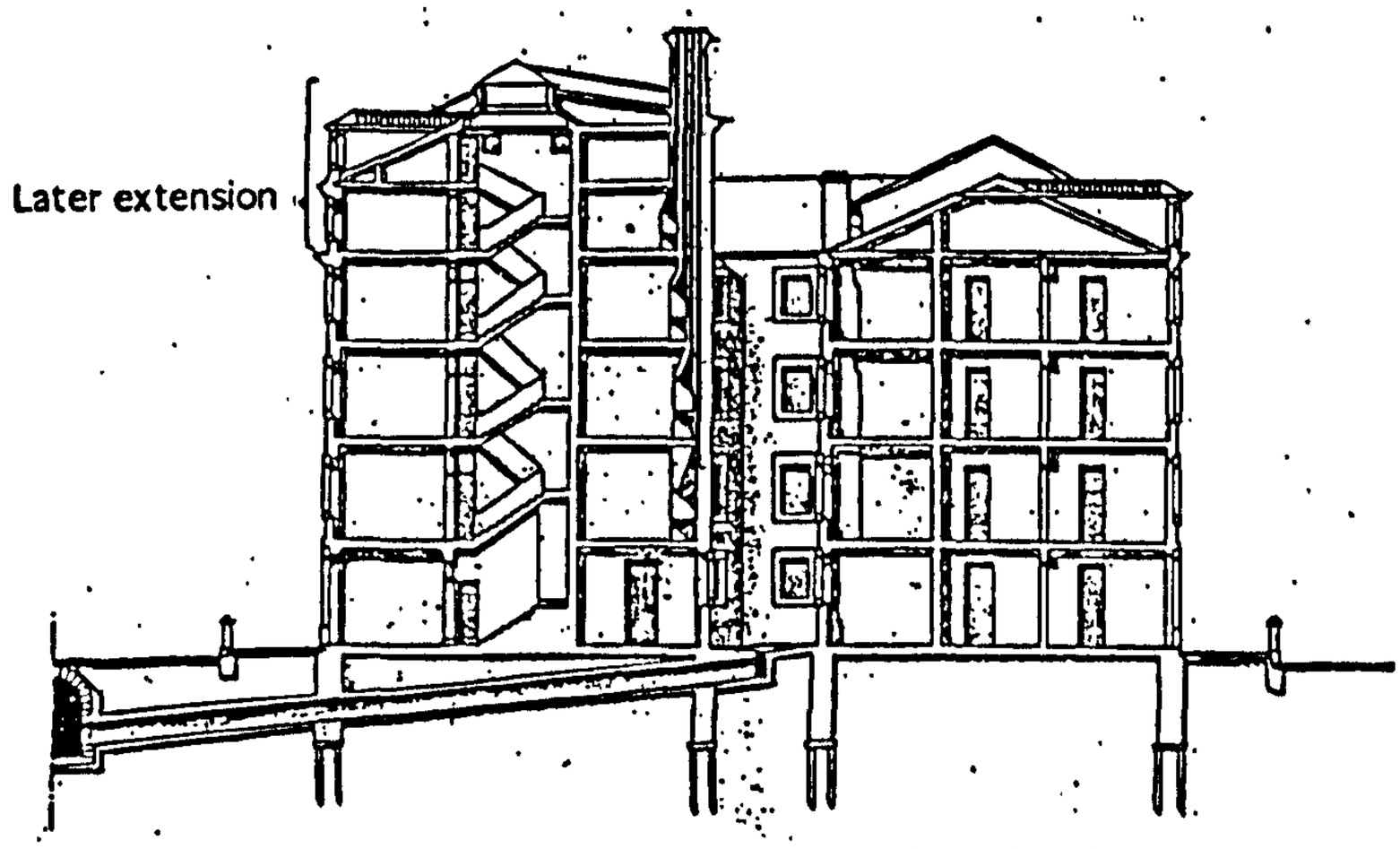


Fig.183-Transverse section of the block.

The internal subdivision of the buildings varies from building to building because the area proportion and position of each building in the blocks is different and also because the reconstruction process took a long time. To better understand the internal arrangement it is necessary to identify the factors that may have determined it. The factors investigated are: the classification of buildings by their stairways, the design of the stairs, and the interior areas of the flats, and their access to natural light.

III.2.3. The classification of buildings by their stairways.

All the Pombaline rentable buildings can be classified as either "left/right", (Fig.184), (two flats to a staircase on each level) or "single" (one flat to a staircase on each level), (Fig.185). The former are far more common, and represent 54.0% of the total whereas the latter represent only 34.3%. This tendency for the former is explained by the fact that one stairway serving two flats per floor is more economical to construct as well as saving space, (see location of buildings on Fig.102).

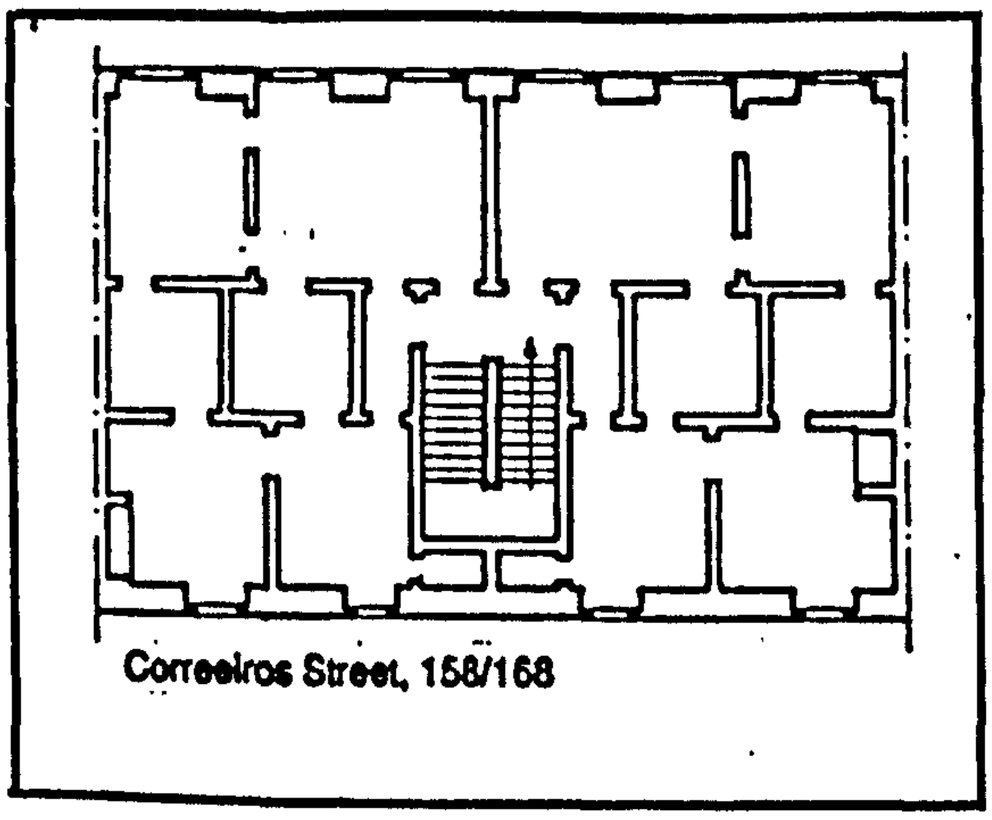


Fig.184-Example of "left/right" stairway

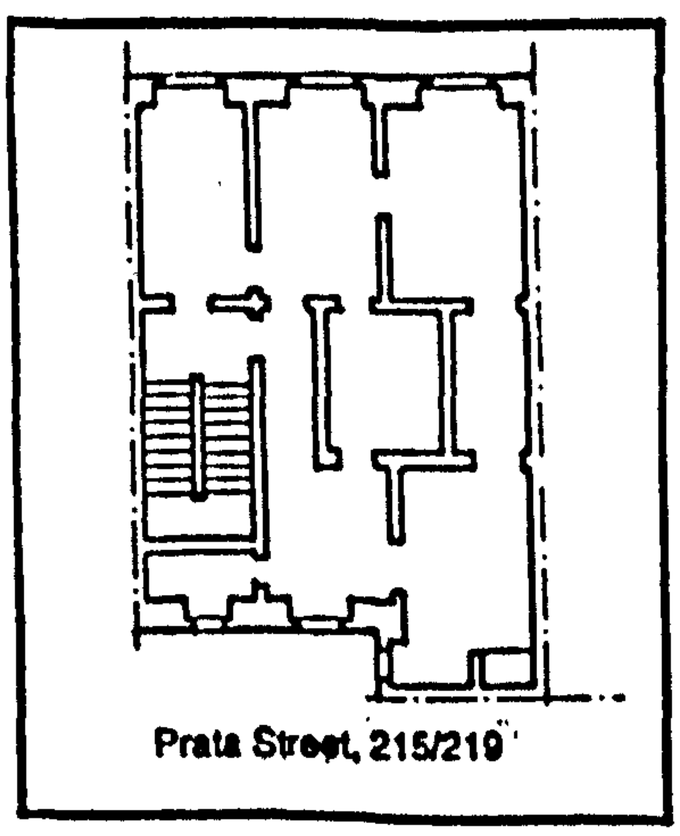


Fig.185-Example of a "single" stairway

The " left/right" layout can be asymmetrical as in Figure 186 or asymmetrical but with a central staircase as in Figure 187 (both combined represent 29.8% of the total number of buildings), almost symmetrical as in Figure 188 (which represents 10.2%), or strictly symmetrical as in Figure 189 (which represents 14.0%).

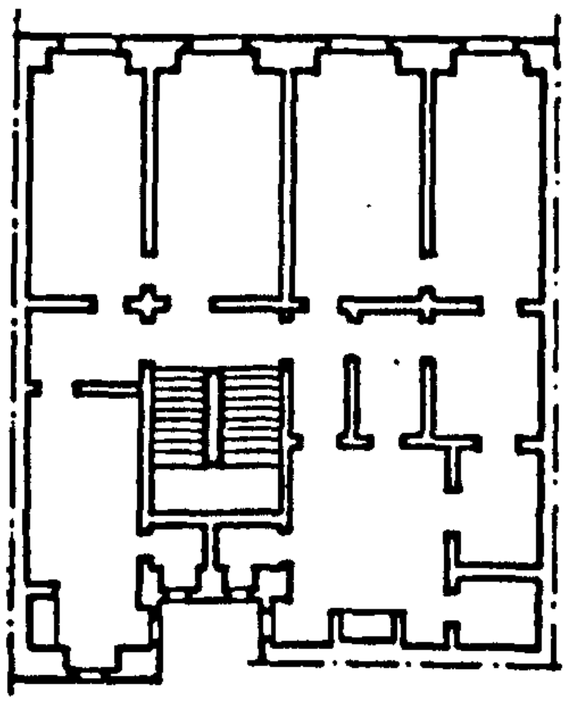


Fig.186-Example of asymmetrical layout.

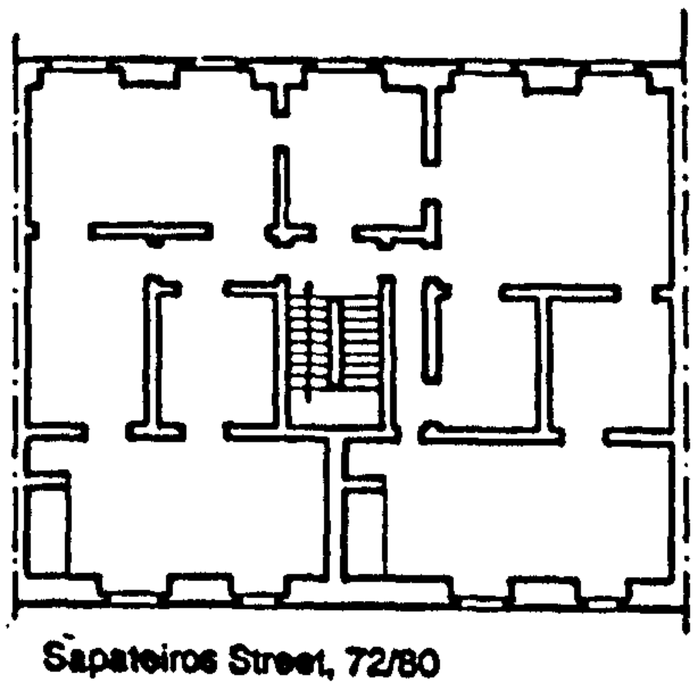


Fig.187-Example of asymmetrical layout. but with central staircase

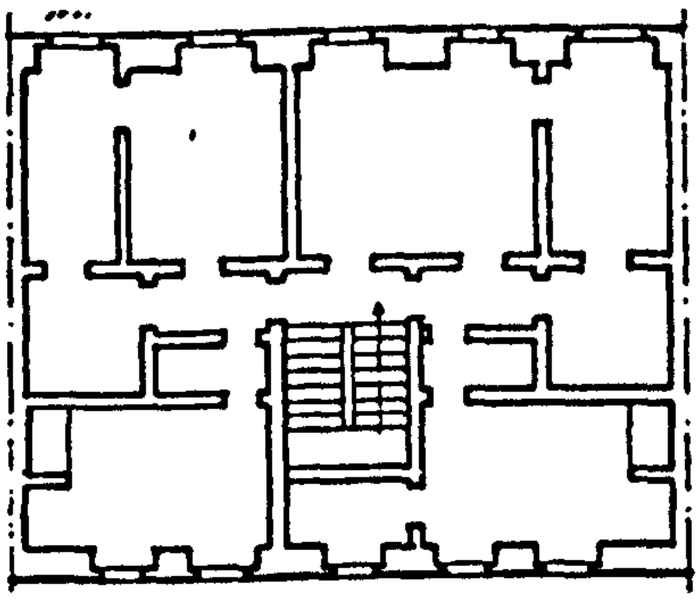


Fig.188-Example of almost symmetrical layout but with central staircase (all the space in front or behind the stairs belonging to only one of the apartments).

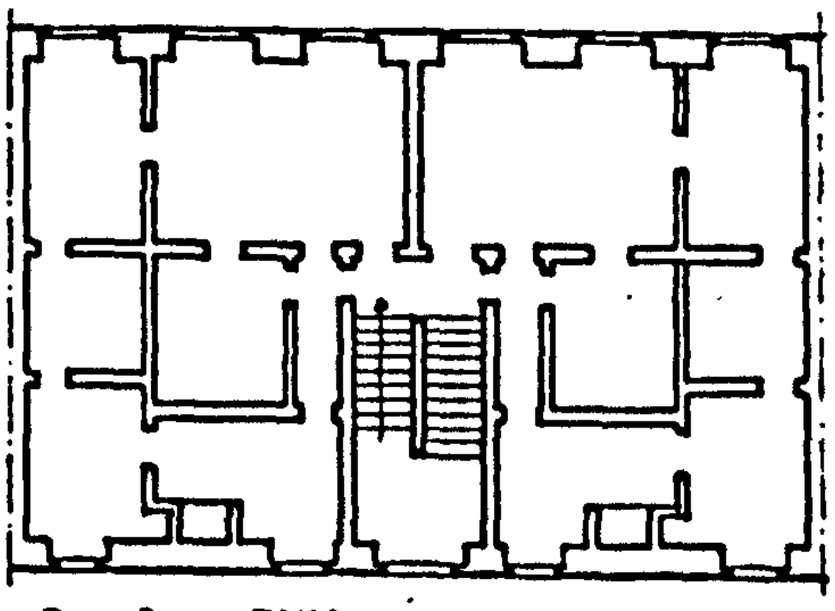


Fig.189-Example of strictly symmetrical layout.

The corner buildings of the "left/right" standard type have asymmetrical flats. The flat which is on a corner has two façades facing the street, which means that there is a greater number of windows and this allows for a different arrangement of spaces. Normally this type of flat has a greater area than the other, (see Fig.190).

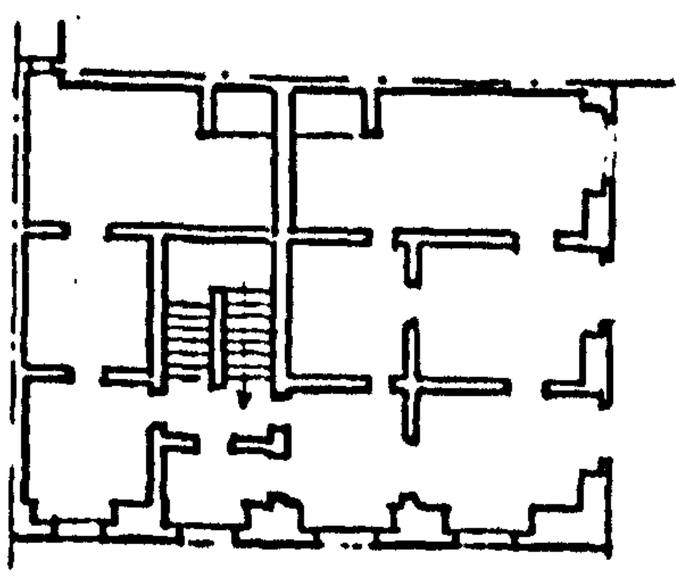


Fig.190-A corner "left/right" layout.

The construction of strictly symmetrical flats is rather difficult; the central wall on the axis of the stairs is supported only by the floor over the entrance hall on the ground floor. This situation was dealt with in two rather ingenious ways, (see Fig.191): One solution was to place the stairway next to the street façade, (Fig.192), and the second was to create an entrance corridor with an offset towards one of the sides, (Fig.193).

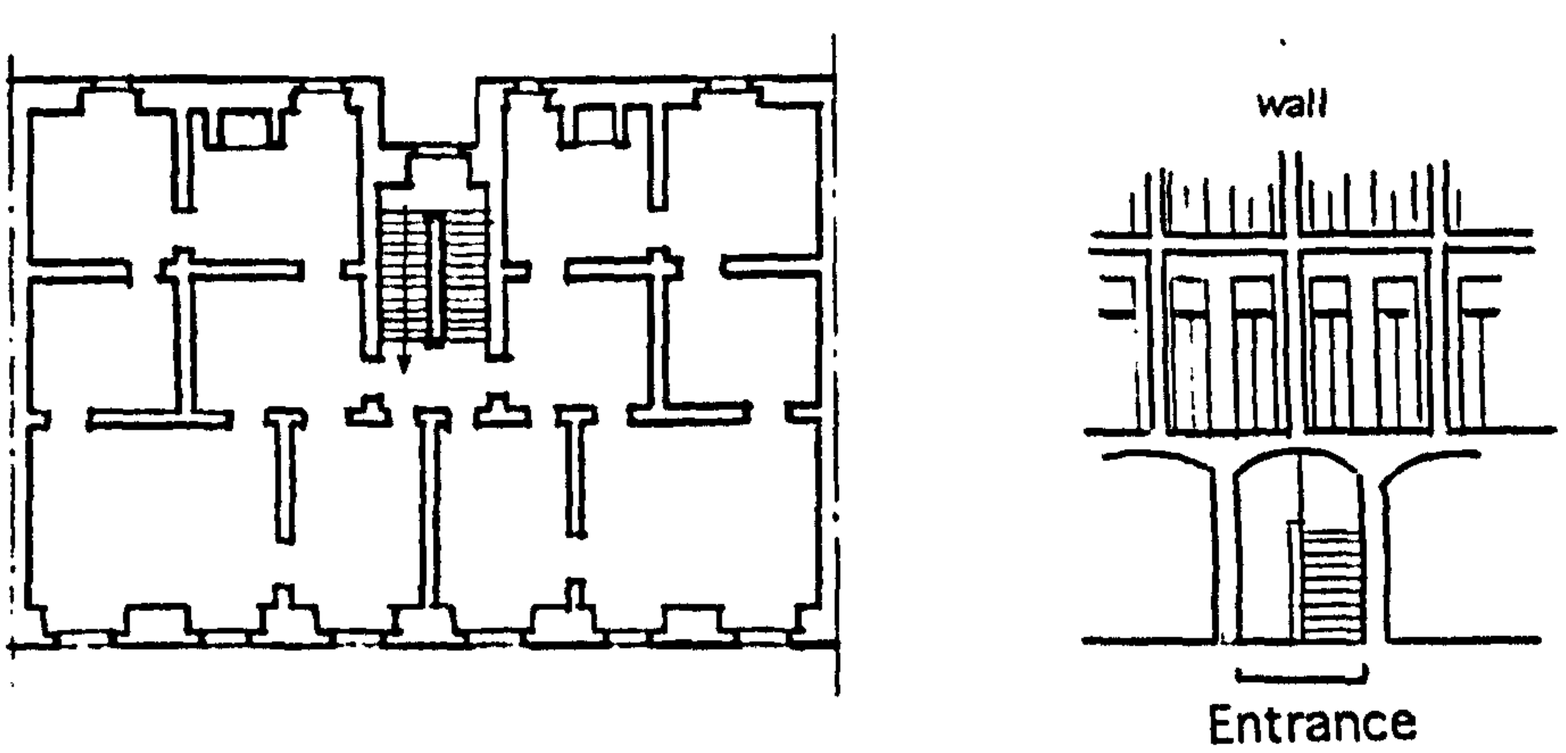


Fig.191-First floor plan and section.

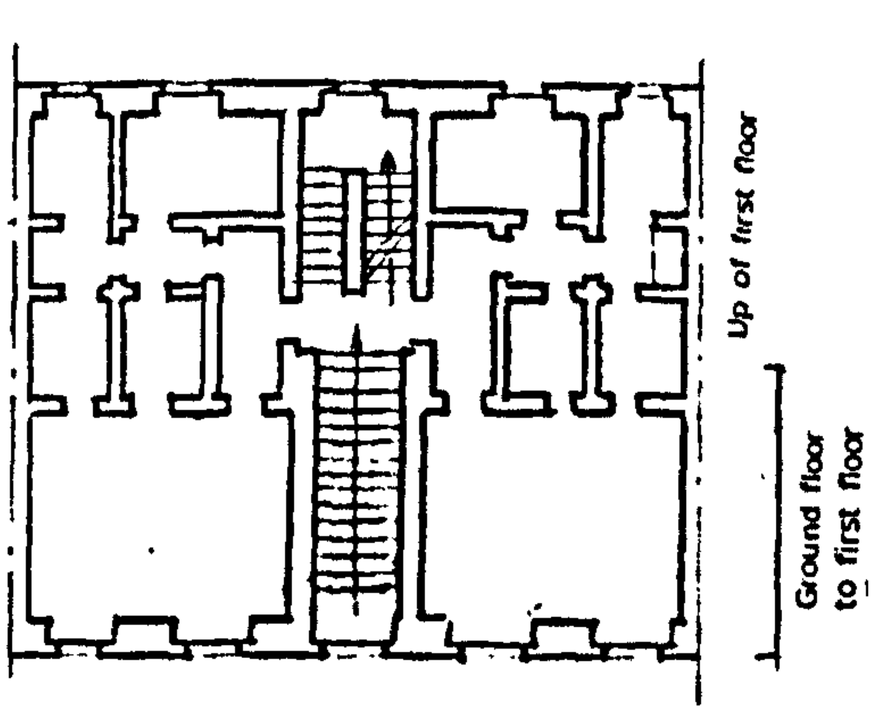


Fig.192-Sol. 1, example of position of stairs on ground and first floor

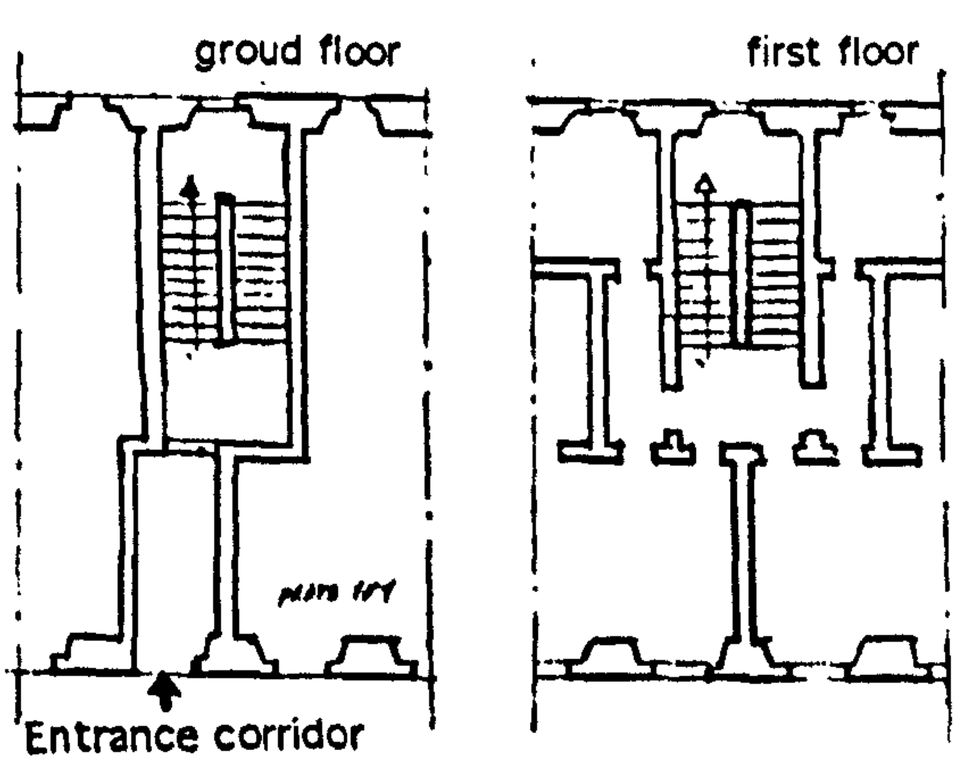


Fig.193-Sol. 2, example of position of stairs on ground and first floor

There are in some cases pairs of buildings which share the same stairs, and for these cases two forms of design are prevalent. They represent only 8.3% of buildings and it is assumed that in these cases this was sometimes done for reasons of economy. In the first case the stairway is built entirely on the inside of one of the properties and the thicker of the two adjoining walls forms the party wall. (Fig.194). In the second case the stairway is built on the axis of the party wall, (Fig.195).

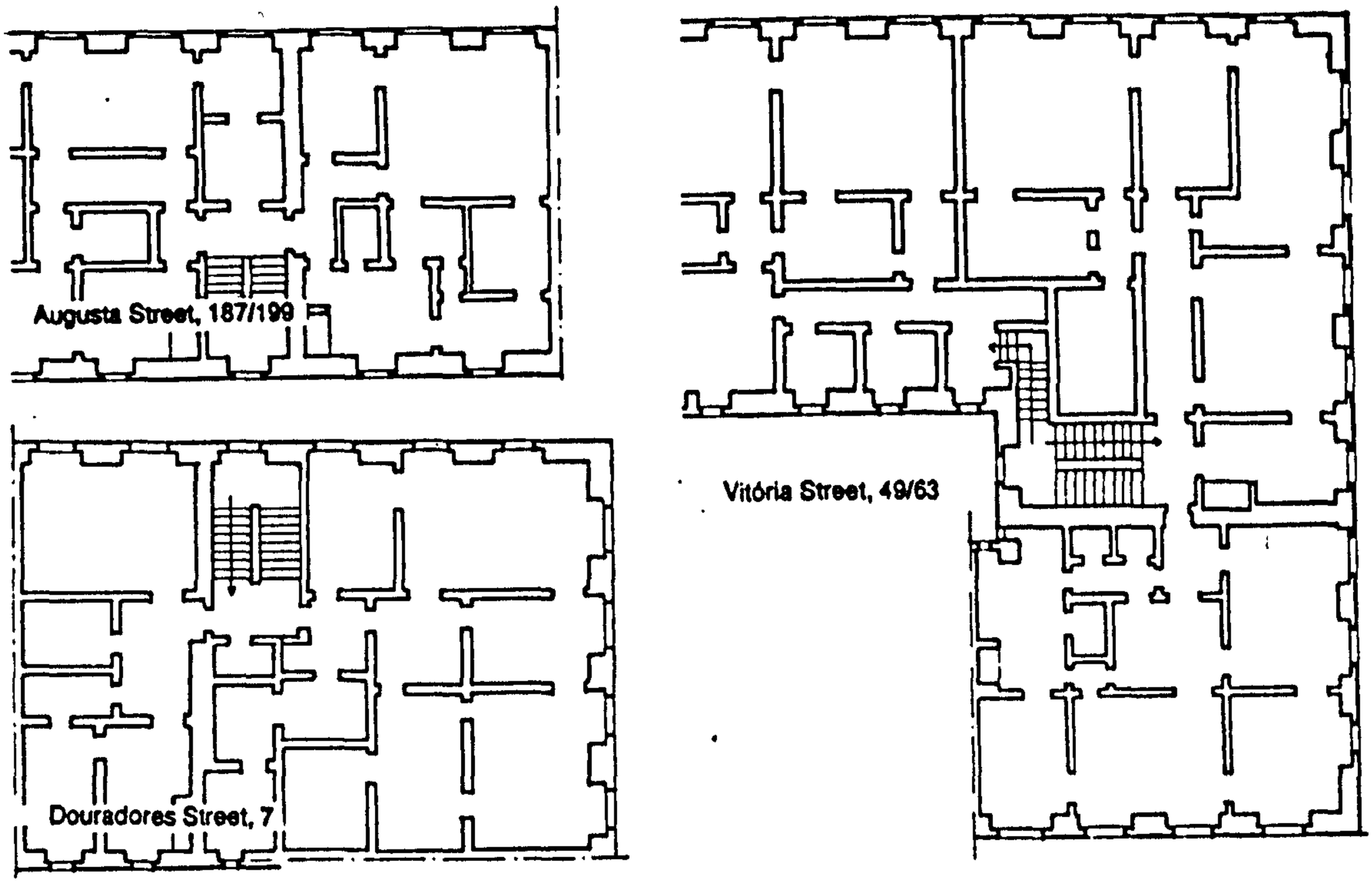


Fig.194-Examples of a stairway built inside one of the properties

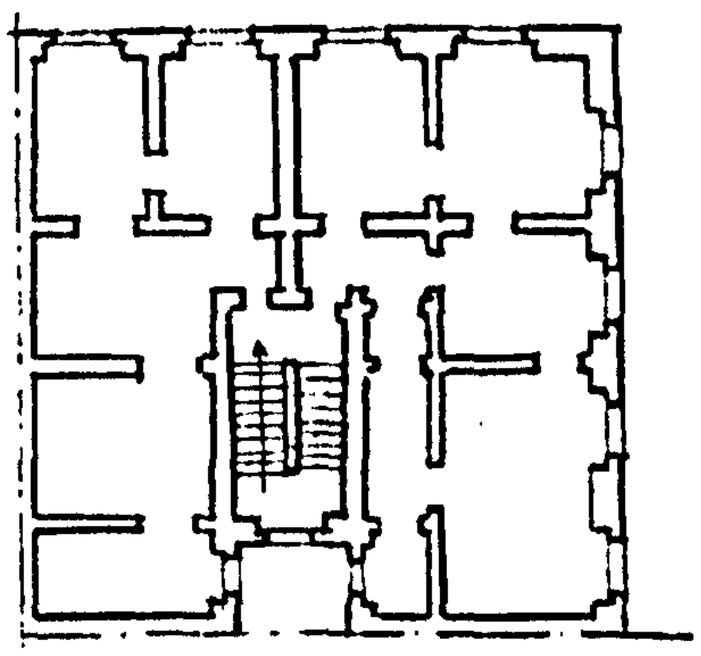


Fig.195-Example of a stairway built on the axis of the party wall

III.2.4. The design of the stairs

The stairs themselves can be divided into seven different types. Type number one which is the most common, has stairs which climb alongside a central "solid" balustrade, with two flights and a half landing between each level, (see Fig.196).

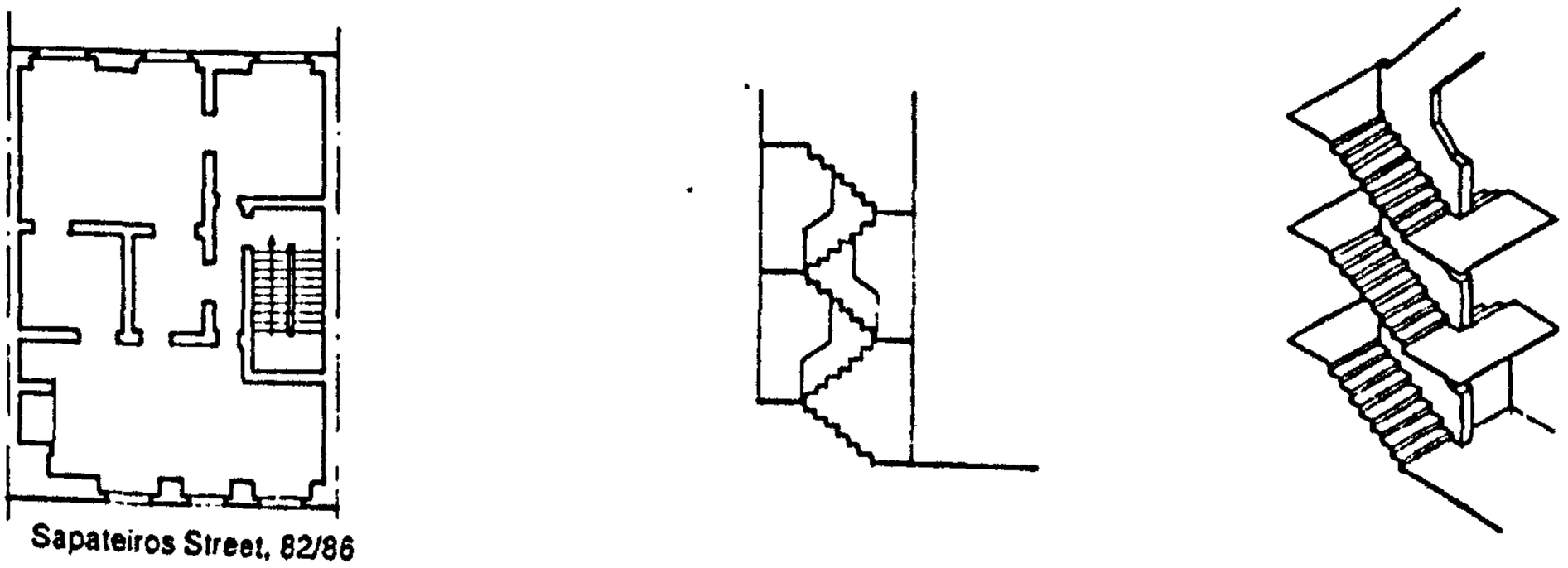


Fig.196-Example of type number one stairway, (plan, section and perspective)

In type number two the stairway is constructed with principal sections occupying most of the height between floors and smaller sections of limited depth giving access to the flats, (see Fig.197).

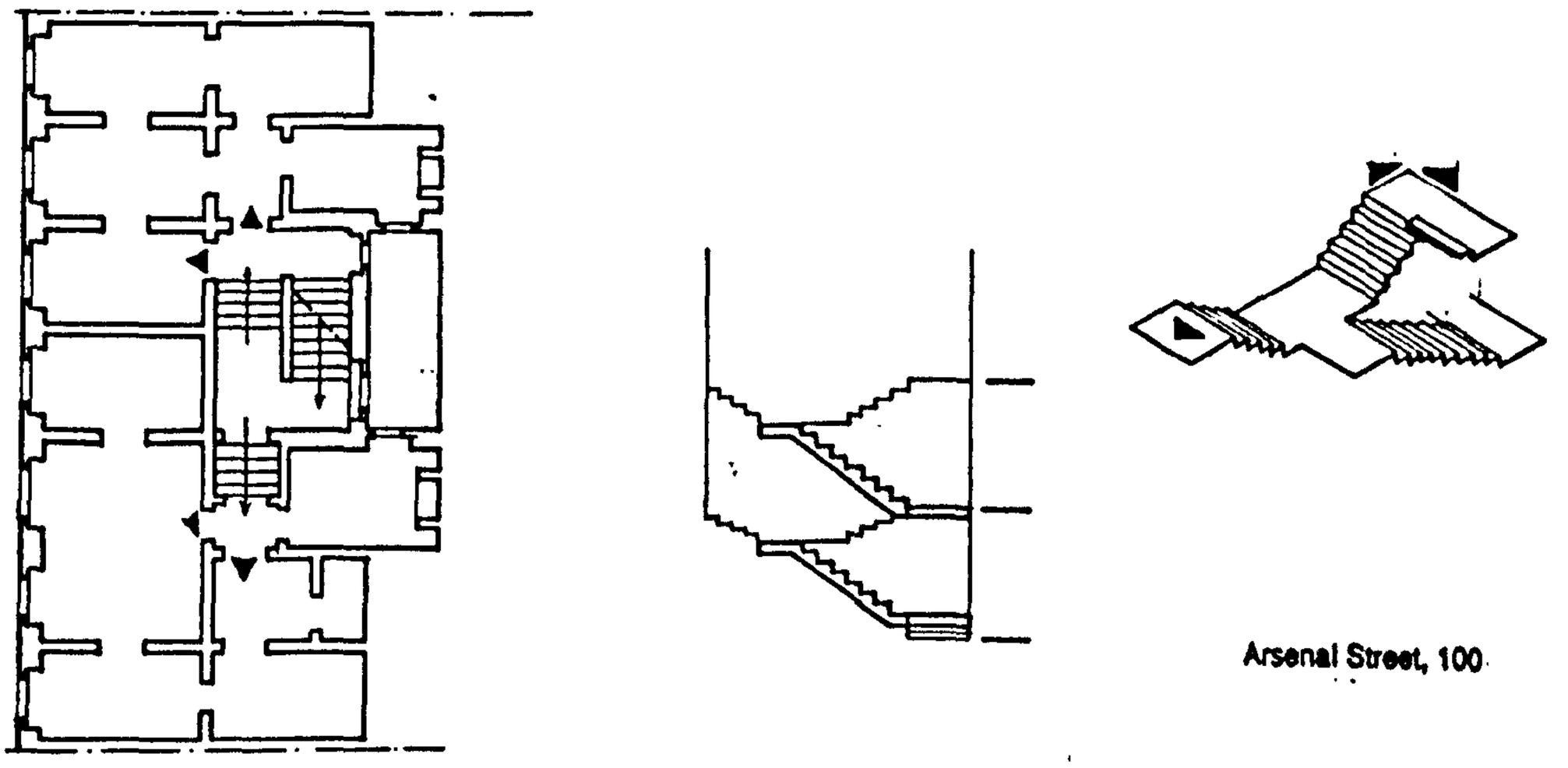


Fig.197-Example of type number two stairway, (plan, section and perspective)

In type number three the principal stairway is similar to type number one but alternate landings have a secondary stairway which provides independent access to the kitchen, (see Fig.198).

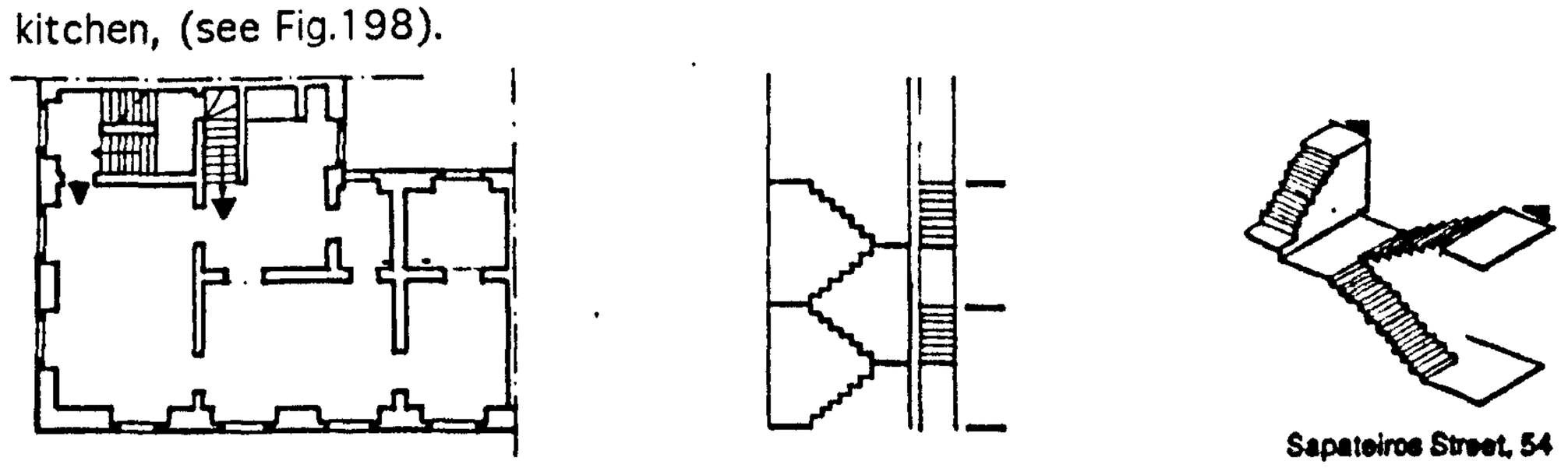


Fig.198-Example of type number three stairway, (plan, section and perspective)

In building at the ends of the blocks there is normally a small flight of stairs from the ground level to link with the main stairway, (see Fig.199).

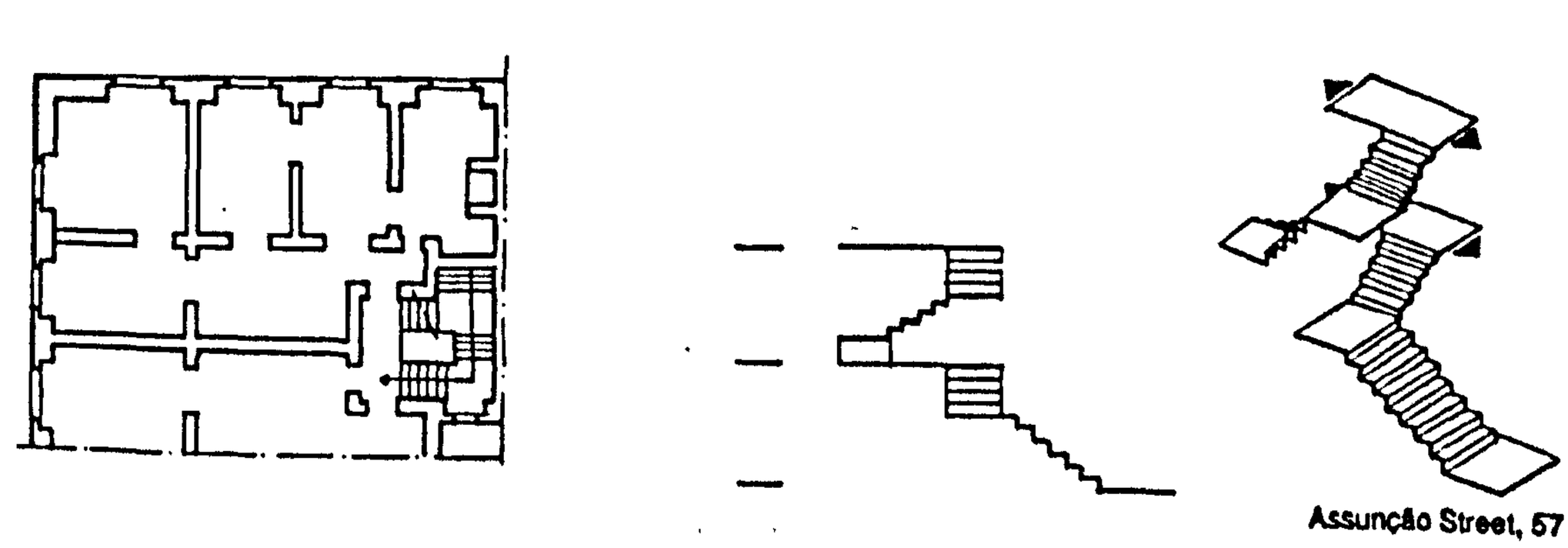
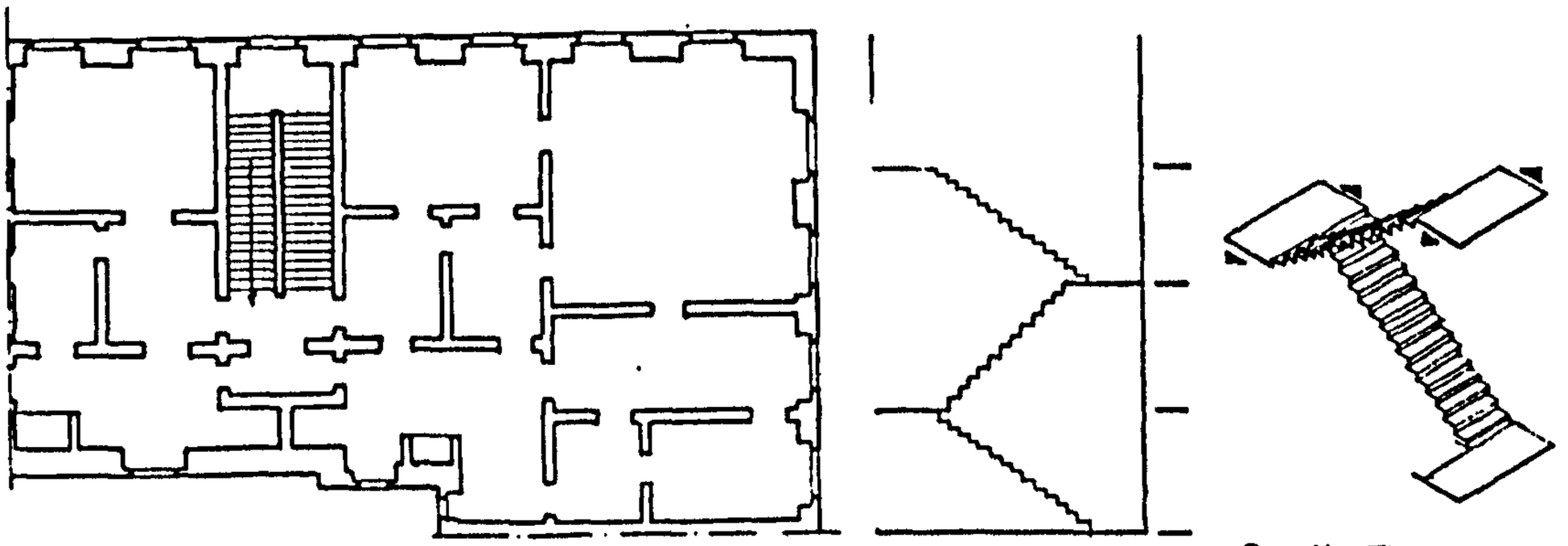


Fig.199-Example of type number four stairway, (plan, section and perspective)

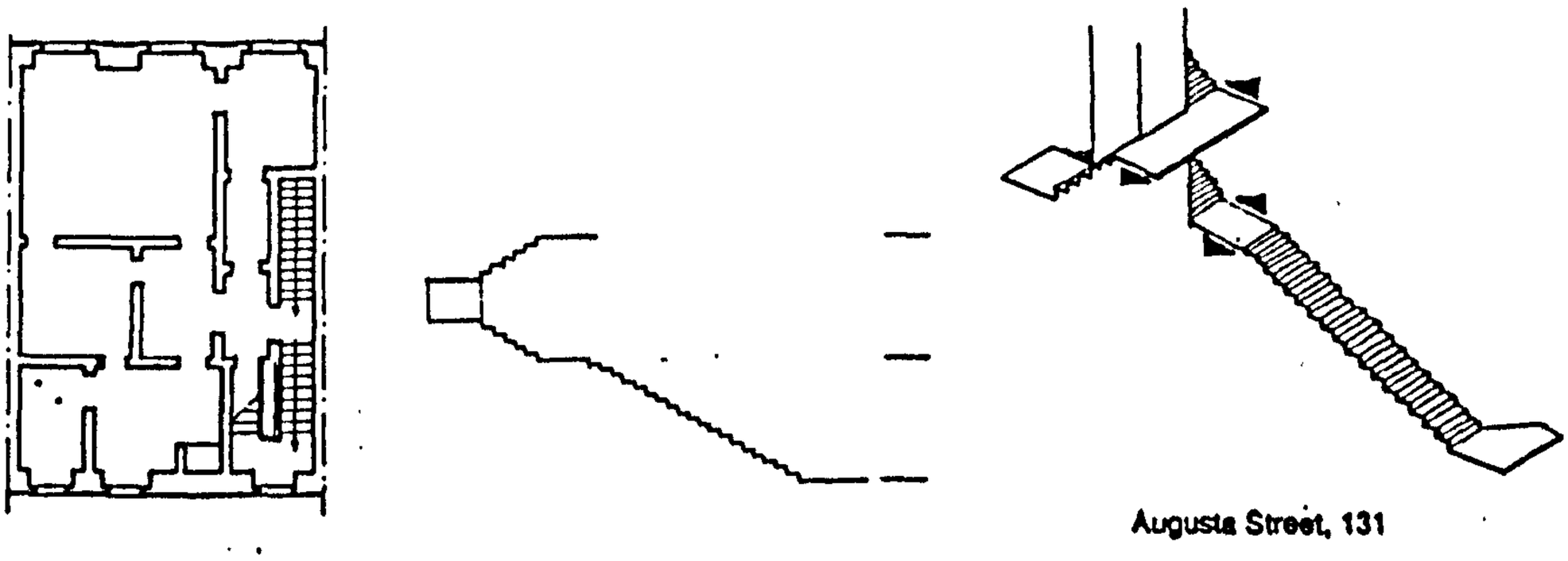
In type number five the stairway runs next to the street façade and there is a single flight of twenty steps to reach the next level, (see Fig.200).



Correiros/Figueira Streets

Fig.200-Example of type number five stairway, (plan, section and perspective)

In type number six the stairway begins directly inside the entrance to the building with one single flight up to the first floor after which it continues in the same direction until reaching the *alfugere* façade, (see Fig.201).



Augusta Street, 131

Fig.201-Example of type number six stairway, (plan, section and perspective).

In type number seven, the stairway is normally located in the middle of the building and climbs around an open newel with two flights and a half landing between each level, (see Figure 202)

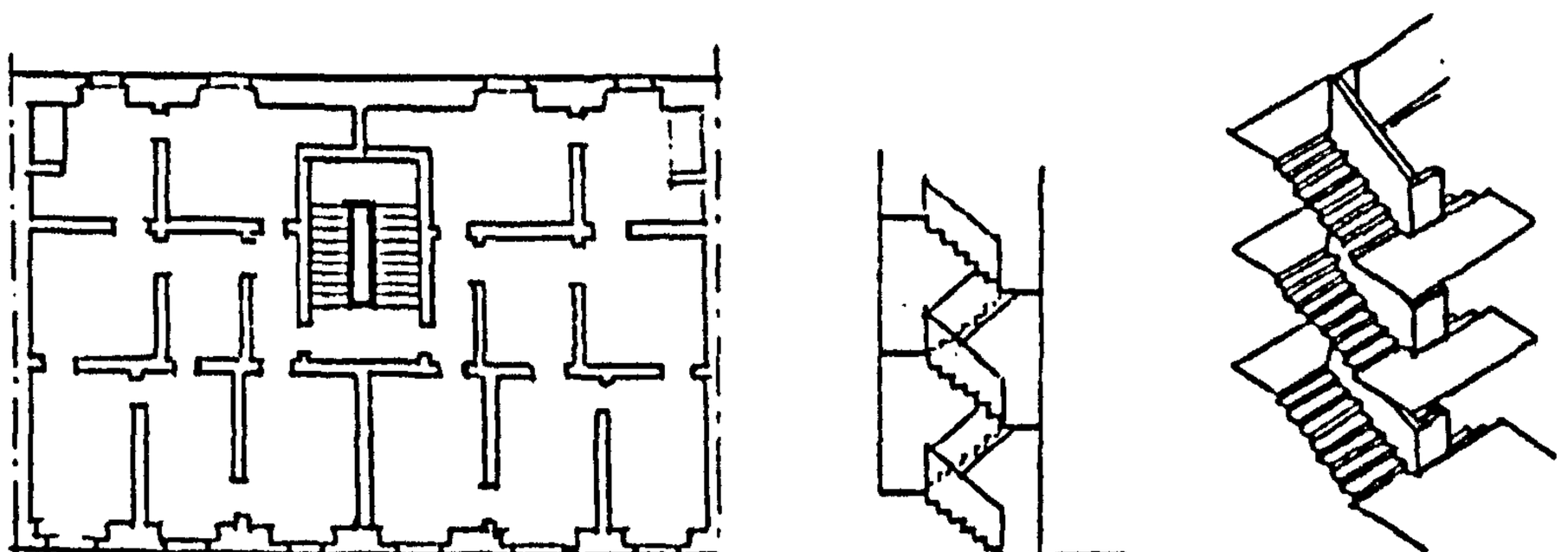


Fig.202-Example of type number seven stairway, (plan, section and perspective).

III.2.5.The interior areas of the flats, and their access to natural light.

Due to the wide variation in the dimensions of the buildings, the number of windows per building varies substantially ranging from two to eight windows facing onto the street, (see Fig.203).

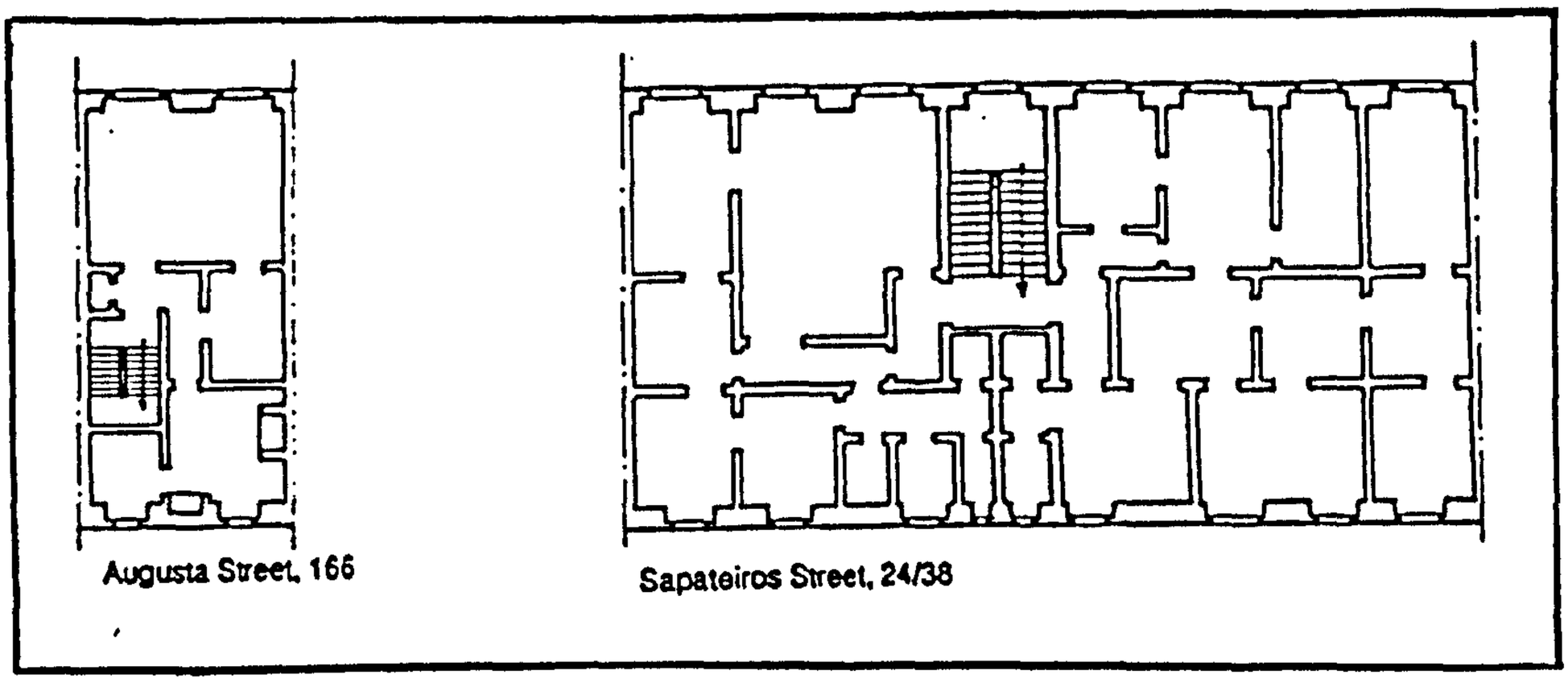


Fig.203-The left: building with two street windows on each floor.
The right: building with eight street windows on each floor.

As shown in Table III.1 most of the "single" flats have three or four windows, and most of the "left/right" flats have five or six windows and always more than four windows.

Table III.1 Percent of a specific building type having a given number of external windows, as a percentage of the total number of buildings. (Corner buildings and buildings belonging to narrow blocks, as the case of n.1, which represent 140 buildings (42%), are not included due to their unique situation. The 42% and the 56,6% of Table III.1 make approx.100%).

Number of windows (to street)	2	3	4	5	6	7	8	9	Total
Left/right type flat %	0	0	3.5	9.2	8.6	5.4	1.5	0.6	28.8
Single type flat %	3.5	11.4	6.3	4.1	2.5	0	0	0	27.8

Flats are normally built three rooms deep from front to back. The rooms adjacent to the street and the alfugere have natural daylight, whereas the rooms located in the middle are the unlit areas which occupy as much as 18.5% of the habitable area for the two flats. Below (Fig.204) are illustrated two examples of corner buildings each with a corner flat and an intermediate or linked flat (the former tending to be different from the flats in intermediate buildings). Corner flats in spite of having more windows also have proportionately more unlit interior areas than the other flats.

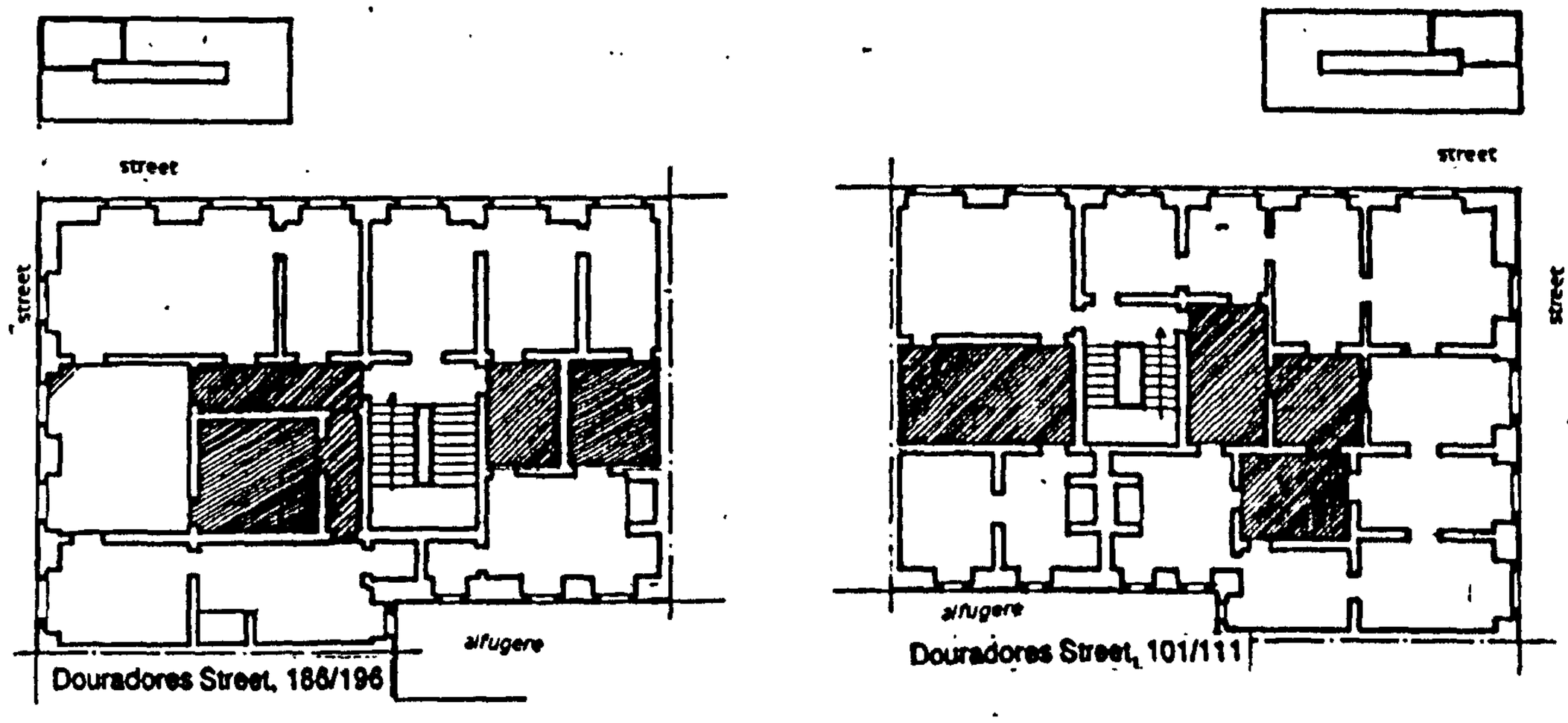


Fig.204-Illustration of the unlit interior areas of a building

Two different approaches were employed to overcome the problem with lighting in the end flats. The first, which constitutes 3.1% of buildings, was to extend the *alfugere* (courtyard) into the corner flat, (see Fig.205). The second, which constitutes 10.8% of buildings, was to provide a separate lightwell, (see Fig.206).

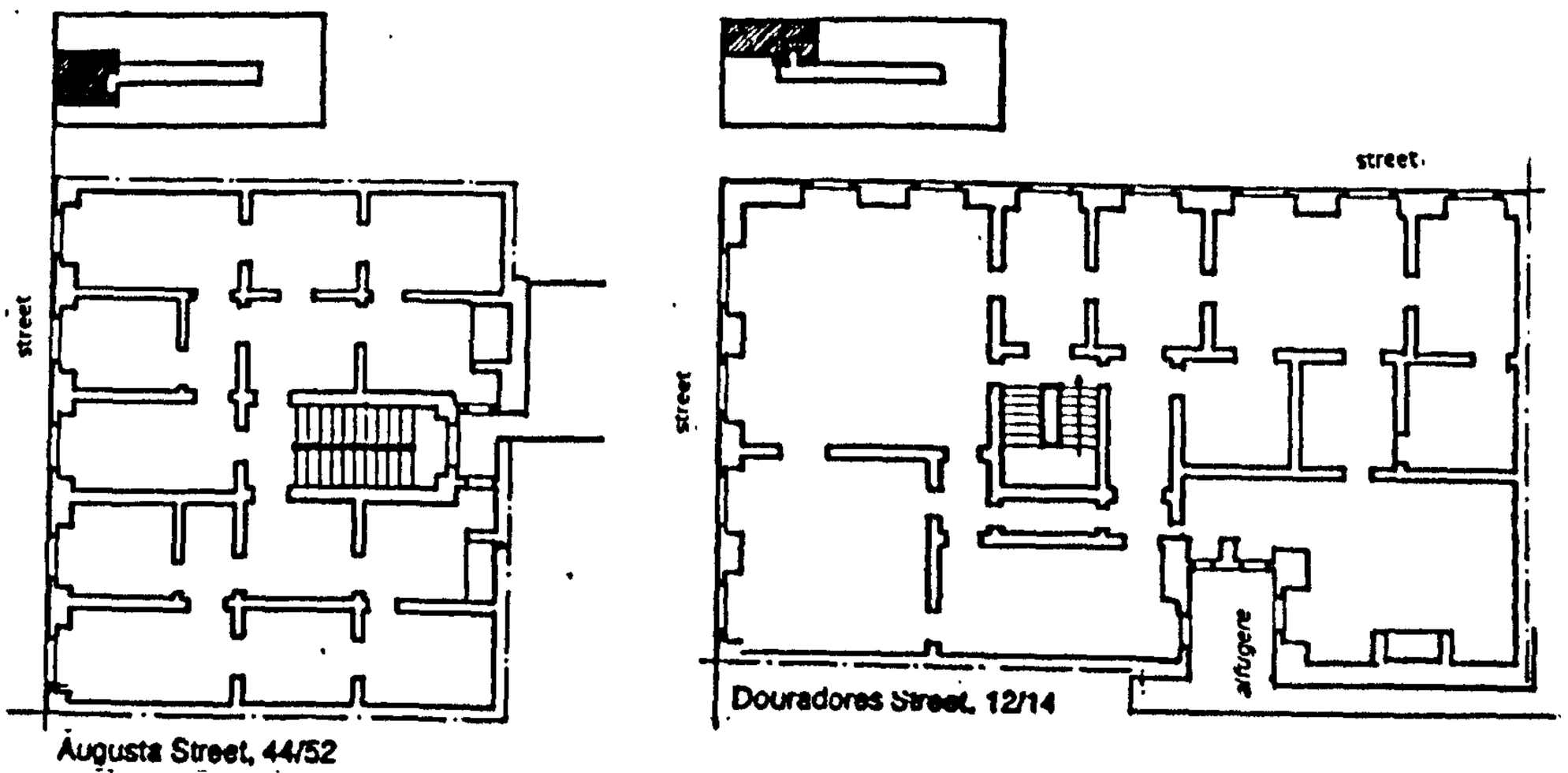


Fig.205-Extending the *alfugere* into the flat.

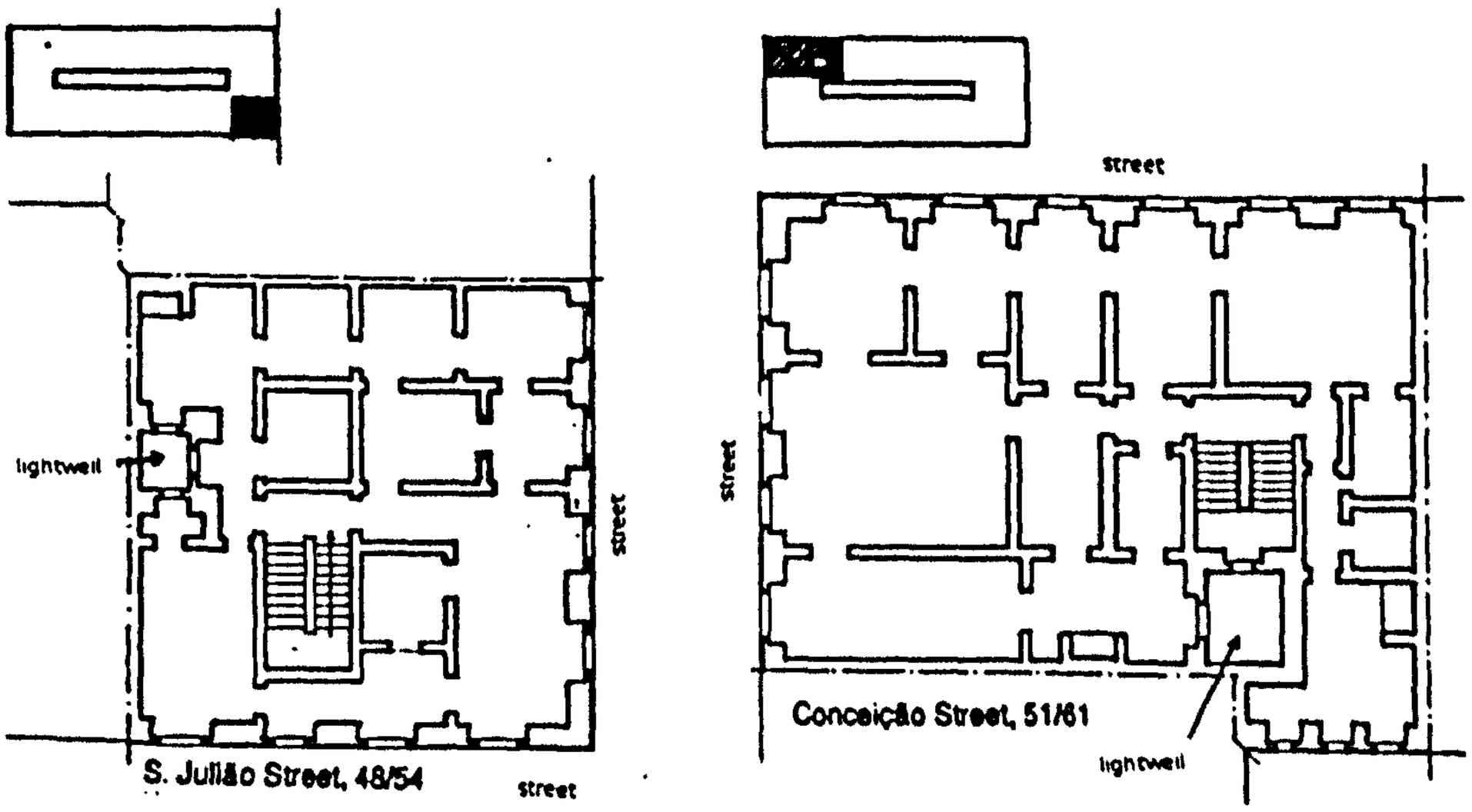


Fig.206-Creating a separate lightwell, built into the corner of the block

The creation of a separate lightwell appears to have been necessary in the following situations:

i) When flats at the end of a block are too big, (Fig.207).

ii)When two different buildings are joined reducing the *alfugere* of the block, (Fig.208).

iii)When flats extend from one side of a block to the other, this situation occurs for narrow blocks, (Fig.209).

iv)When the apartments are situated in the corner of the block and the small area is not able to have a common *alfugere*, (Fig.210)

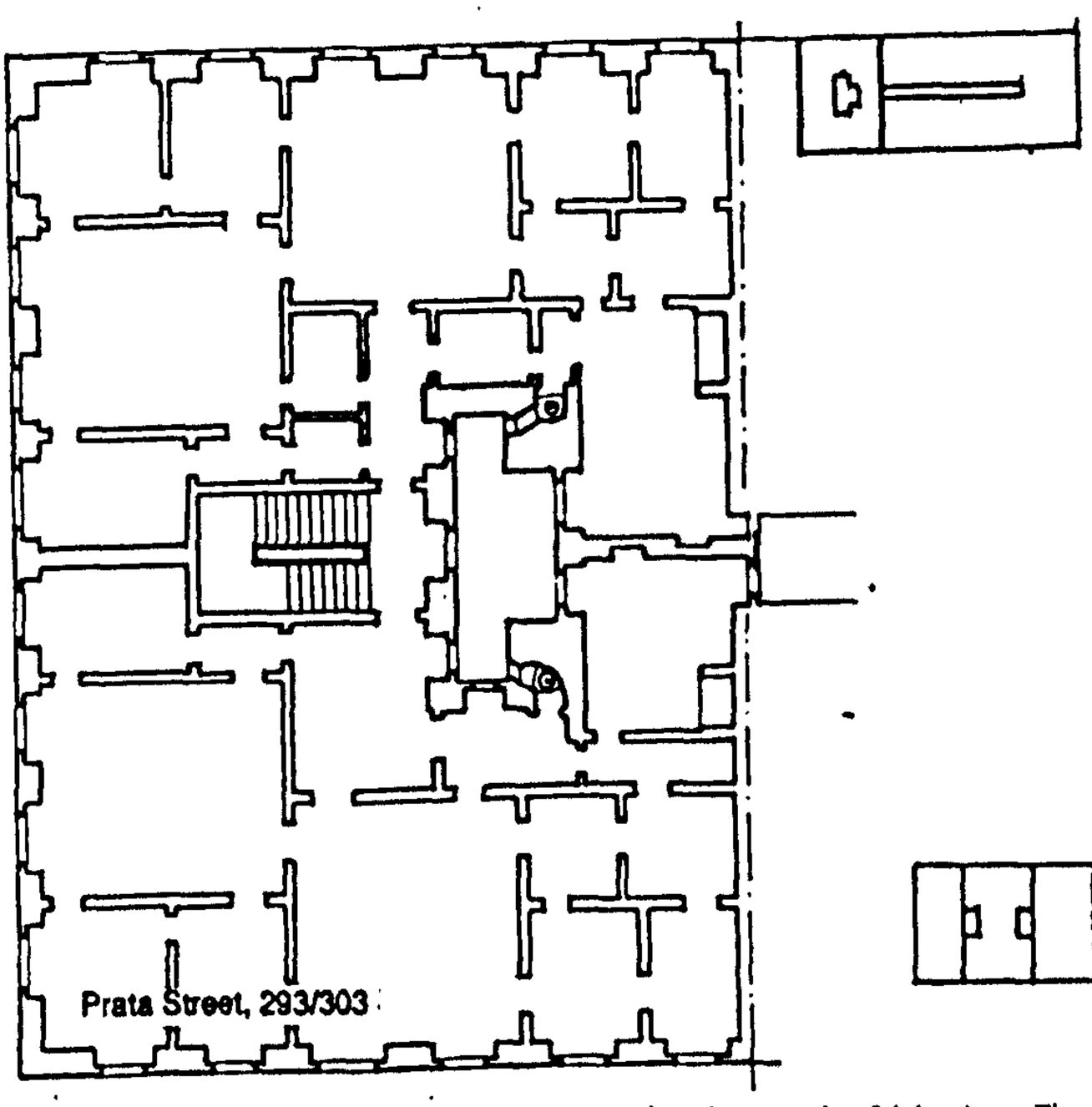


Fig.207-Separate *alfugere* in the end of block

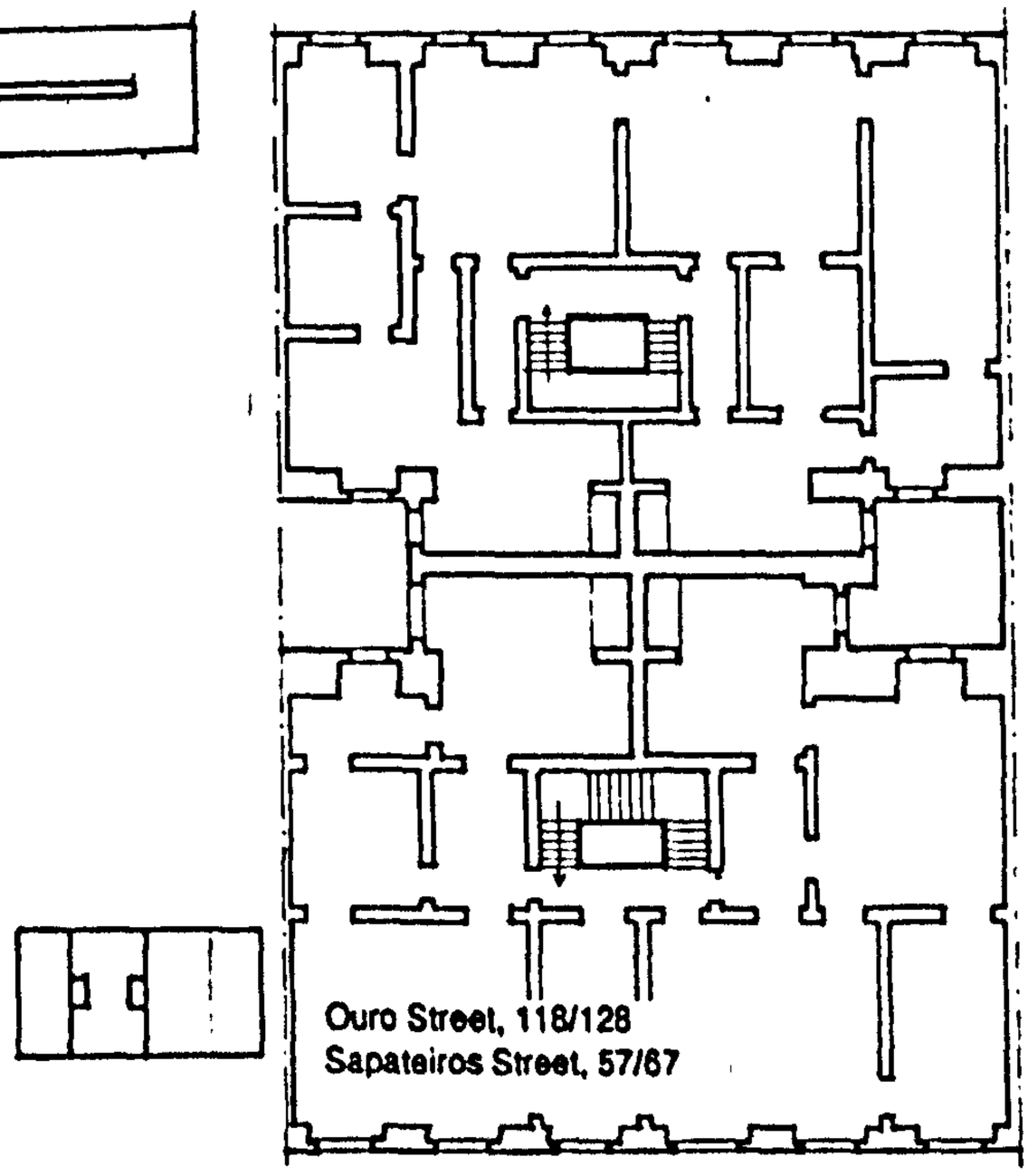
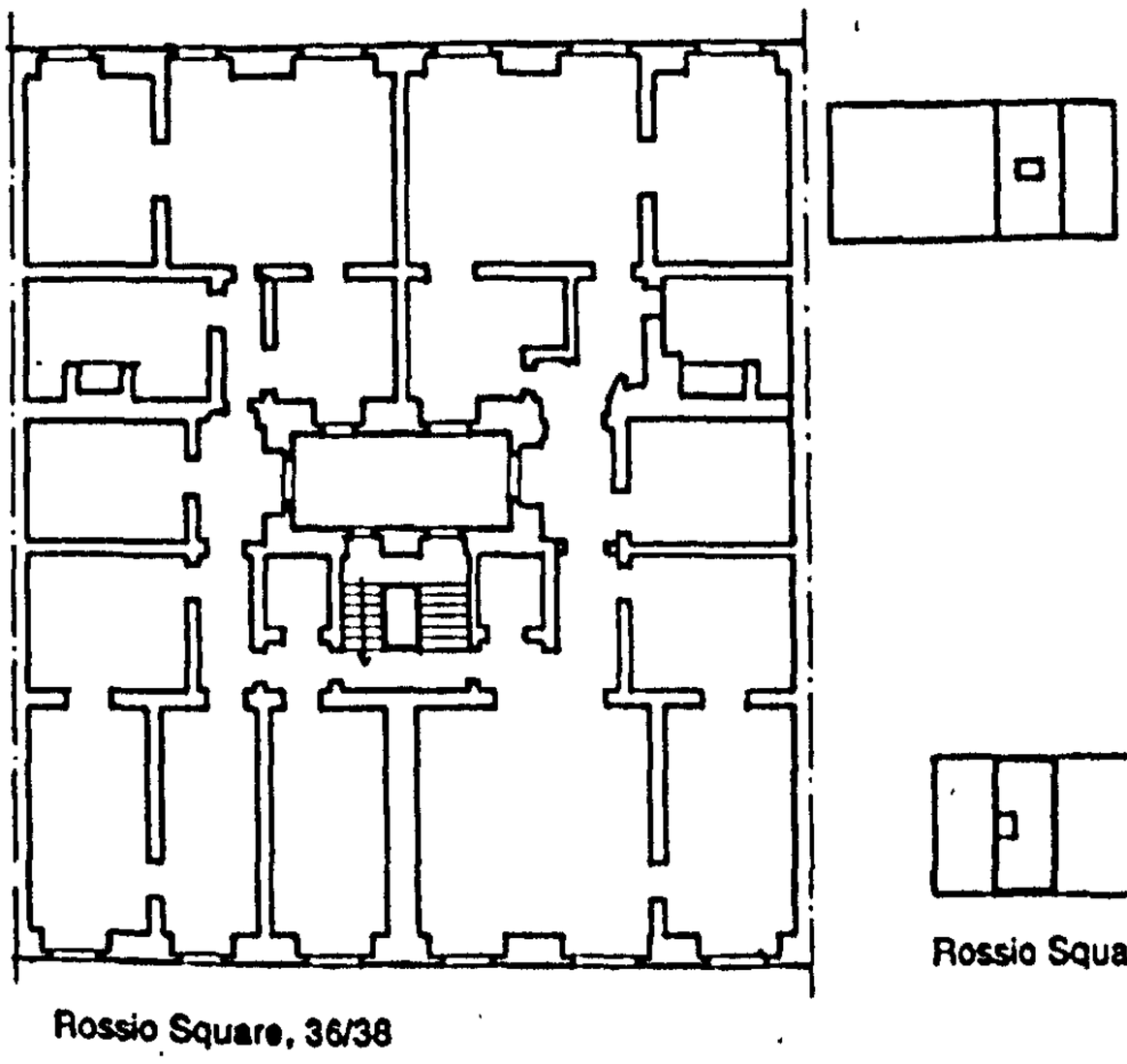


Fig.208-Two opposite buildings when joined



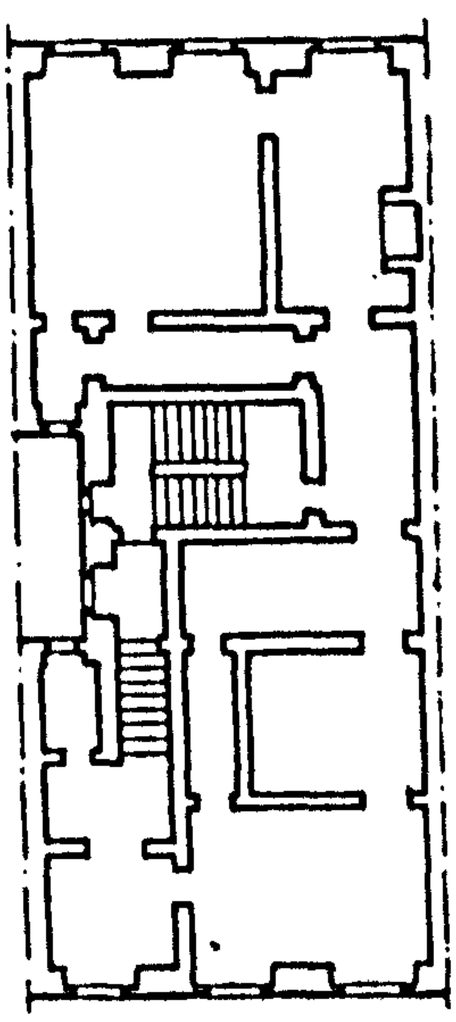
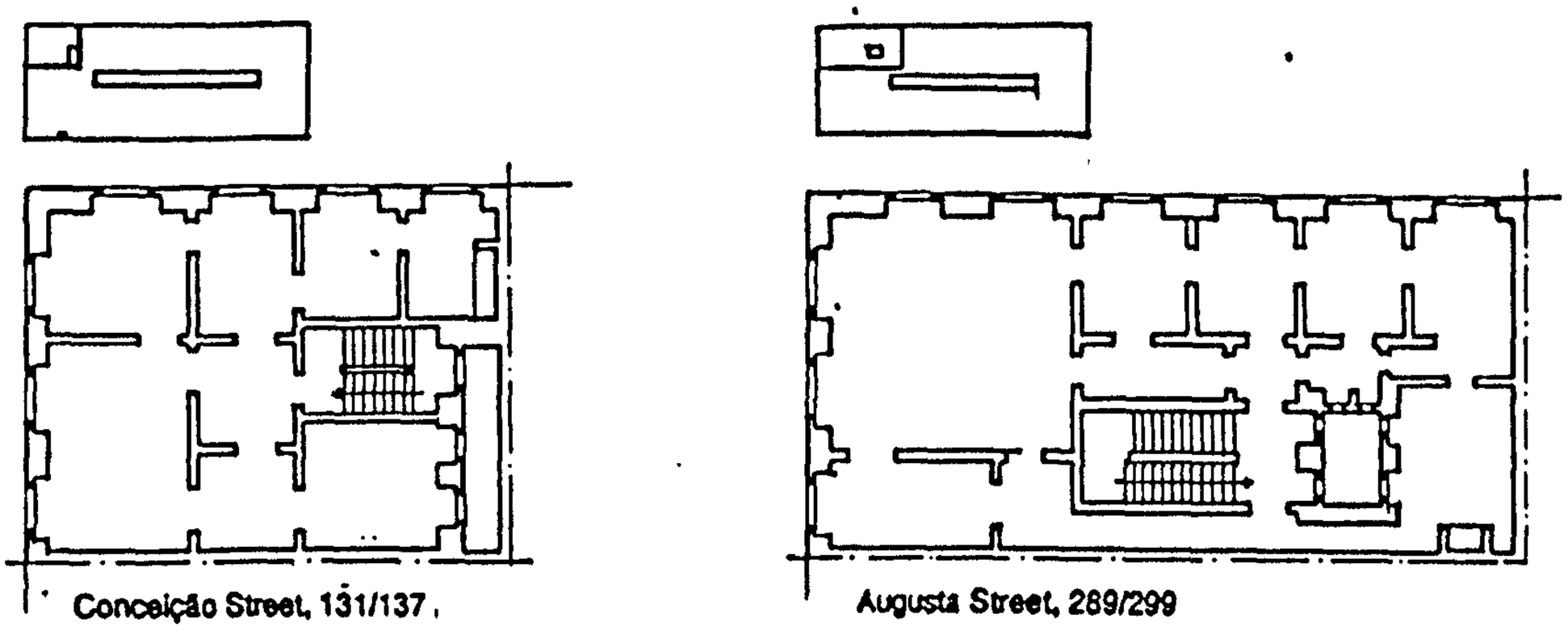


Fig.209-Example of a narrow block illustrating the "left/right"case (left) and the "single" case (right).



Conceição Street, 131/137.

Augusta Street, 289/299

Fig.210-Small flat in a corner, with the *alfugere* located in the end of the flat (left), and the *alfugere* located in the central area (right).

III.3. Summary

The present chapter has examined the architectural characteristics of the Pombaline rentable buildings, firstly describing and classifying the exteriors and then describing and classifying the interiors. After a careful analysis of the exteriors, and the details and different compositions of the façades, a complete classification has been proposed from which it is concluded that the exteriors of the buildings were rigidly imposed during the whole construction period (1760-1830) with minor deviations. The interiors of the buildings are however diverse. In order to understand the internal arrangement, a number of factors which probably influenced and conditioned the interior plan layouts and disposition have been identified and analysed.

It is possible to classify the buildings in a number of ways which include the type of stairway, the number of windows, and the disposition and location of each building within a block. Of these three classifications, the type of stairway, which is less restricted by external constraints than the other two, clearly has a significant influence on the definition of the interiors and could be related to a possible evolution.

In conclusion there appears to be no relation between the different types of interiors and the six different classifications of types of exterior. Although the different types of exterior were clearly imposed, with respect to the locations of the buildings, the interiors which have a great variation seem not to be conditioned by location, position or size.

Before studying their possible evolution the next chapter describes the technical innovations and the health and safety measures incorporated within the design and construction of the buildings and discusses the evidence that dimensional co-ordination and prefabrication strongly conditioned the form of buildings produced.

The author analyses the layout of the streets, the composition of the façades of the buildings and the internal plans and identifies underlying geometrical relationships and presents evidence and argues the case for dimensional coordination and for prefabrication of components.

CHAPTER IV-TECHNICAL INNOVATIONS

In the past, in periods of relative stability cities have evolved by gradual adaptation to change, and building systems have developed in an empirical manner. The 1755 earthquake produced immediate devastation and a period of very rapid change which demanded innovation and instantaneous response in order to meet the enormous challenges and ensure survival in the event of another serious earthquake.

What was required was large scale rapid construction to restore the area to the successful commercial centre which it had been. However, coupled with this was the need to construct buildings which would resist any future earth movements and would avoid some of the worst features of the previous buildings with respect to safety and hygiene. These undesirable features had compounded the problems caused by the earthquake, with respect to fire, access, injury and subsequent disease and illness.

Some of the principles adopted to ensure safety, such as symmetry and simplicity, coincided with the need for rationalisation demanded by the scarcity of resources. In addition the need for rapid reconstruction of the city was satisfied by innovations in standardisation of construction and by the pre-fabrication of many components.

IV.1.Health and safety measures

The reconstruction of the new city started with a remarkable feat of engineering. What remained of the old city was razed to the ground, creating a raised platform above the water level with the rubble. This reduced the likelihood of flooding by rising tides and also reclaimed some of the land from the river, (Fig.211) (2).

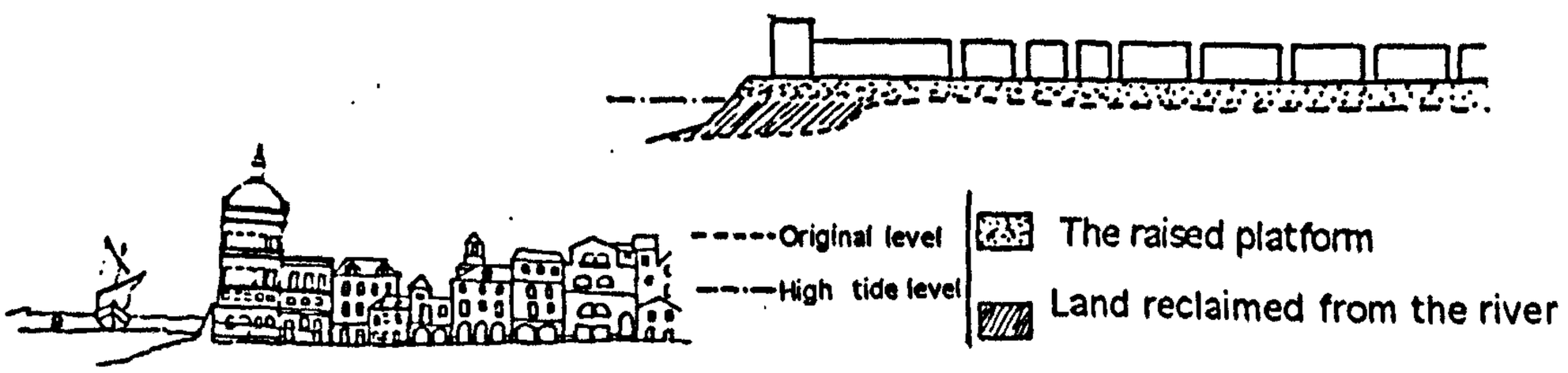


Fig.211-The level of tides and platform, before and after the earthquake

A sewage system was built, which not only removed domestic waste that could inundate the land thus increasing its instability, but also drained away all the water from the neighbouring hillsides (Fig.212) (20).

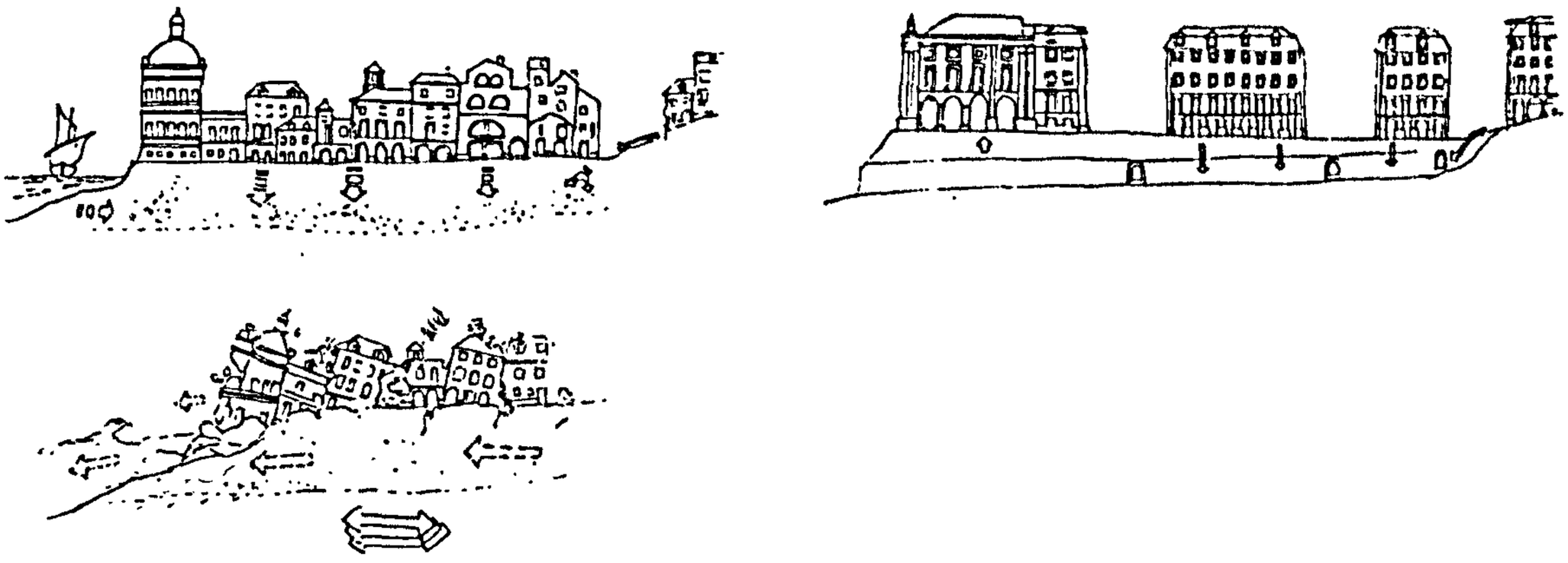


Fig.212-The infiltration of waste before and after the earthquake

The plan adopted for the reconstruction achieved an interesting balance between safety and functional demands in an area of intense economic activity.

According to descriptions, during the earthquake the tremors were predominantly oriented in the longitudinal direction of the creek. Therefore in the new plan, care was taken to line up the blocks in this direction so that they would be better able to withstand any tremors. The only exception was that of the very important, old "Rua dos Ferros", next to the Praça do Comércio, which remained unchanged, (Fig.213)[2], possibly due to its particular historical significance.

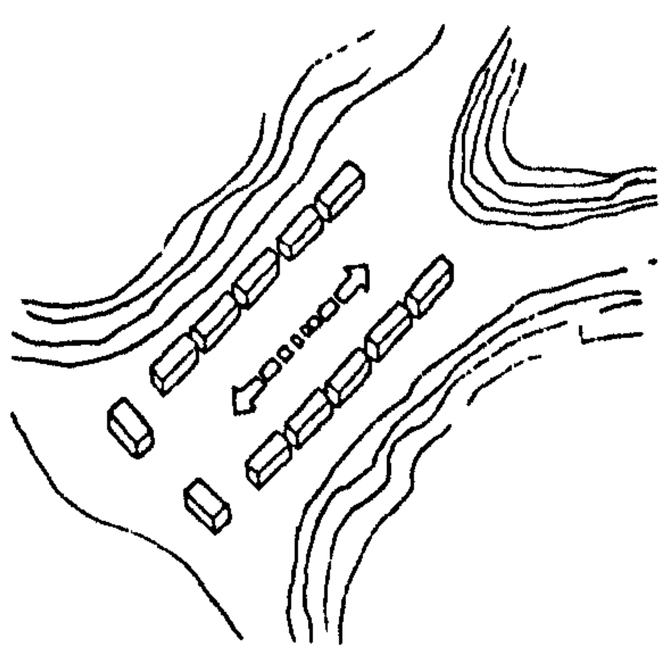
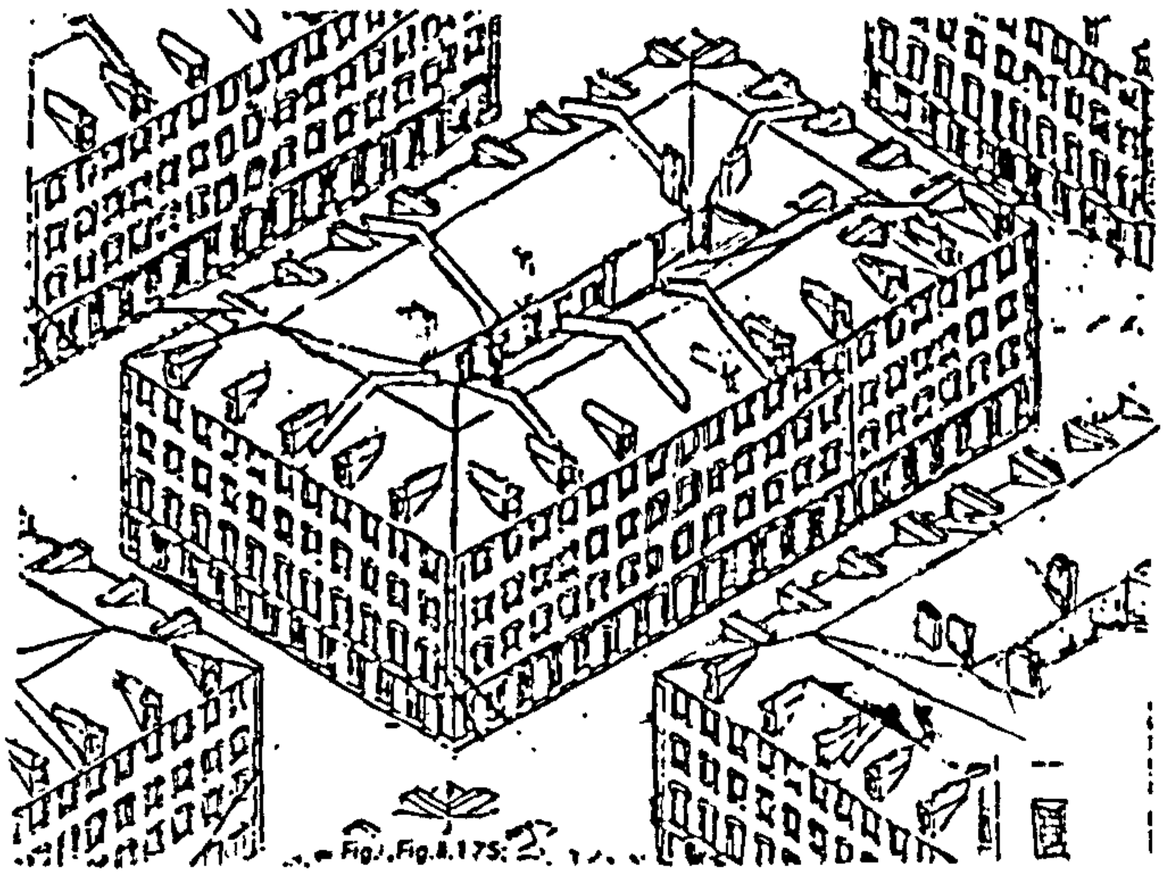


Fig.213-The predominant orientation of the tremors

The orientation of the blocks also created a clear link between the two main squares to make it easy for people to escape in case of disaster. Also to improve safety, the streets were widened and had separate zones for horses and for people on foot with handcarts [2, 22].

The buildings were grouped together in rectangular blocks which increased their stability. The cornerstones were solidly built in stone with the windows placed at a fixed distance from them, (Fig.214).



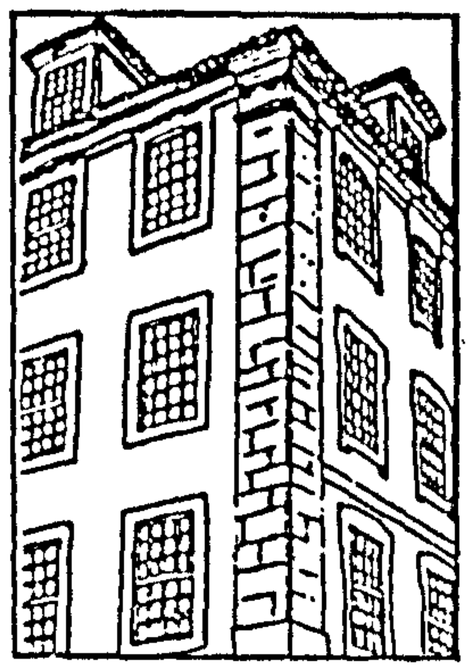


Fig.214-Example of block and a corner

In order to guarantee the necessary ventilation and lighting for the buildings, the maximum height of each building was equal to the width of the main street and all the blocks had a courtyard (*alfugere*) which allowed people to be rescued in the event of disaster. Rubbish was also deposited in the *alfugere* rather than in the streets [2].

As discussed in the previous chapter the façades were carefully defined, simple and repetitive. No obstacles such as steps, flower beds, or any other decorative or utilitarian element was allowed, so that in case of disaster there would be nothing to impede the inhabitants in escaping. Also verandahs were only allowed on the first floor in the main streets and squares [2, 22].

Most of the building units had the stairway placed over the axis, which as well as increasing the stability of the building in terms of torsion, also made them more economical. This is because it allowed owners to share the same stair, consolidating a typology which is still today that most commonly seen in Portugal, that of two homes per level, (Fig.215).

The plans of the different levels were always divided into three parallel sections, two next to the façades and one in the interior. The partition walls were highly flexible (constructed of lath and plaster), which was safer than solid walls, in the event of a tremor, (Fig.216).

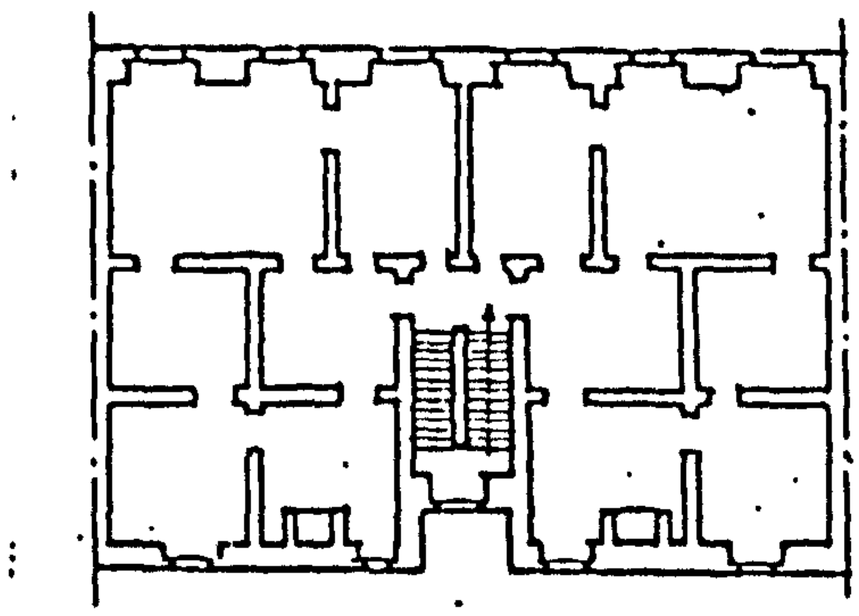


Fig.215-The symmetrical plan

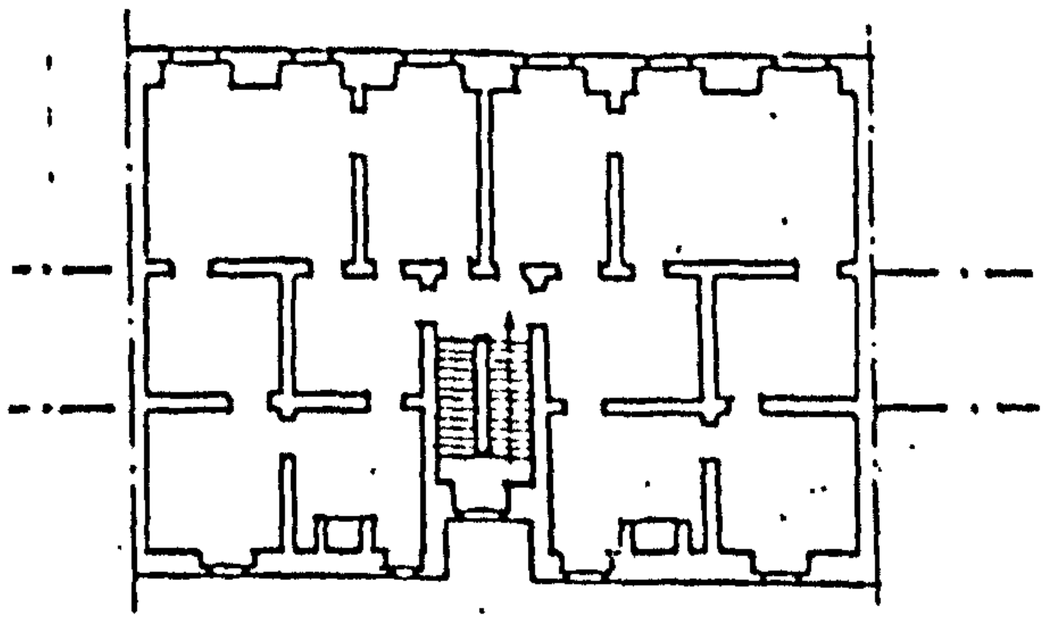


Fig.216-Three division fronts

The spaces in the façades were composed to achieve a perfect balance of forces, (Fig.217). The stonework around the spaces was designed with shapes that adapted perfectly to the tensions within the façade. Also it was tied to the structure of the building and thus, stone elements would not be projected onto the street below in the event of a minor tremor (Fig.218), although in a major tremor it would allow release of the walls from the structural cage.

The roofs of the different buildings had to be at the same height and were separated by fire walls, making it difficult for fire to spread from one building to another, (Fig.219A)[49]. Care was also taken to separate the buildings from one another with thick walls, and no openings whatsoever were allowed to be made there , (Fig.219M).

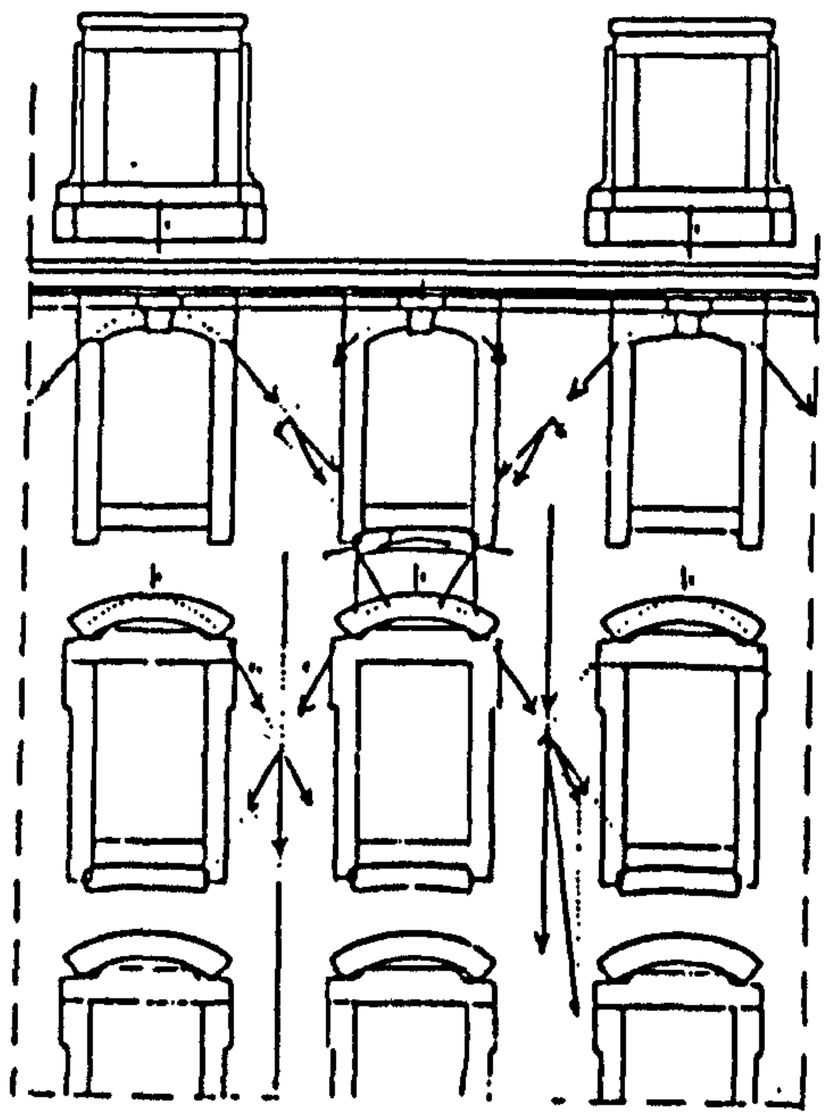


Fig.217-Balances of forces in the façades

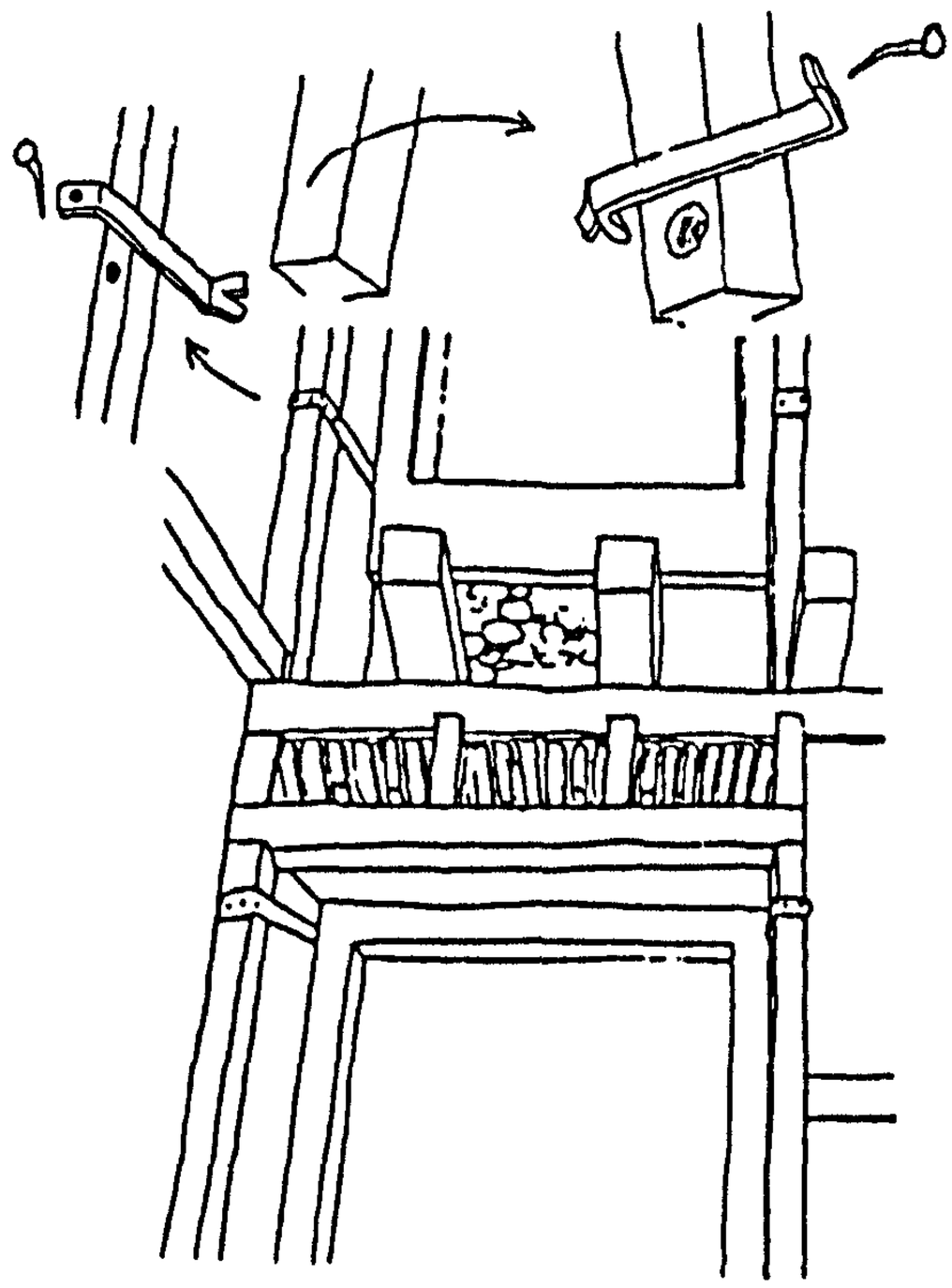


Fig.218-Iron element fitting the stonework to wood structure

To guarantee the stability of the buildings on unstable land, an ingenious system using stakes was built, (Fig.219B). It has been possible for the author to study and record details of the foundations and the superstructure, because over the last ten years nineteen of the buildings have either been partially or totally destroyed (see section II.5.2.) to make way for more modern new buildings. In the event of an earthquake, the system of solid arches (Fig.219C) sitting on the timber rafts which are themselves supported by a distribution of short timber "piles" about 1.5 metres in length (see Figure 219B), would allow movement but would prevent the foundations from collapsing[50].

The ground level was usually covered by vaults (Fig.219D) resting on thick stone walls and pillars, so that if there were a fire at shop level this would not spread to the apartments above. The stones in the pillars were carefully worked so that these would fit exactly into one another. Care was also taken to isolate the hall leading to the stairs, which went up to the apartments from the shops, and when there were doors these were covered with metal sheet. For the same reasons, the stairs to the first floor, were made of stone (Fig.219E).

For both economic and safety reasons, the stairs mainly had two straight flights with a landing between them. The stairs in most cases climbed around a wall which made it difficult for the smoke to rise in case of fire. Also the stair network with its five walls contributed to the stability of the building, (Fig.219F). In some cases the stairs were positioned next to the courtyard façade and this made it easier to provide light and to enable residents to be rescued in the event of a disaster, (Fig.219G).

Eaves were designed with the lowest three courses of tiles at a more shallow angle to prevent them slipping off into the street, (Fig.219 I).

The austerity of the decoration also contributed towards safety, the only decorative feature being the three courses of tiles of the dado (Fig.219J) which were non-combustible.

Balconies consisted of a stone slab in order to prevent the spread of fire from the warehouse or shop doors to the french windows on the first floor, (Fig.219K)

The ceilings are simple consisting either of wood planks from the floor above which are clearly visible, without any plastering, or of plaster, and in both cases without decoration. Decorative features could easily be broken away in a tremor and injure the residents (Fig.219L). Also the floor beams are fixed to perimeter walls by means of metal straps, (Fig.219N) [49].

In order to be able to construct, on unstable land, buildings with three floors which would remain intact in the event of an earthquake, an ingenious wooden structure was adopted which already existed in some buildings before the earthquake. Examples of early medieval buildings on Castle Hill are currently being restored by the Municipality in Lisbon (Gabinete Técnico de Alfama) and have been observed by the author. However the wood structure in these buildings appears to be much more rudimentary than that of the Pombaline buildings which have a much more regular and systematic cage structure. The structure, called the "cage" or "gaiola" is made up of a series of vertical and horizontal struts joined by diagonal pieces forming Saint Andrew's crosses, (Fig.219H). The positioning of the sections is based on the empirical principle that it is difficult to deform a triangle [51, 52]. On the lower levels, the modulation is repeated whereas in the area of the stairs it is reinforced with horizontal sections.

It is claimed by França [20] that the "gaiola" was carefully tried out and perfected by military engineers before being applied, (between 1756-1760). It had a complex

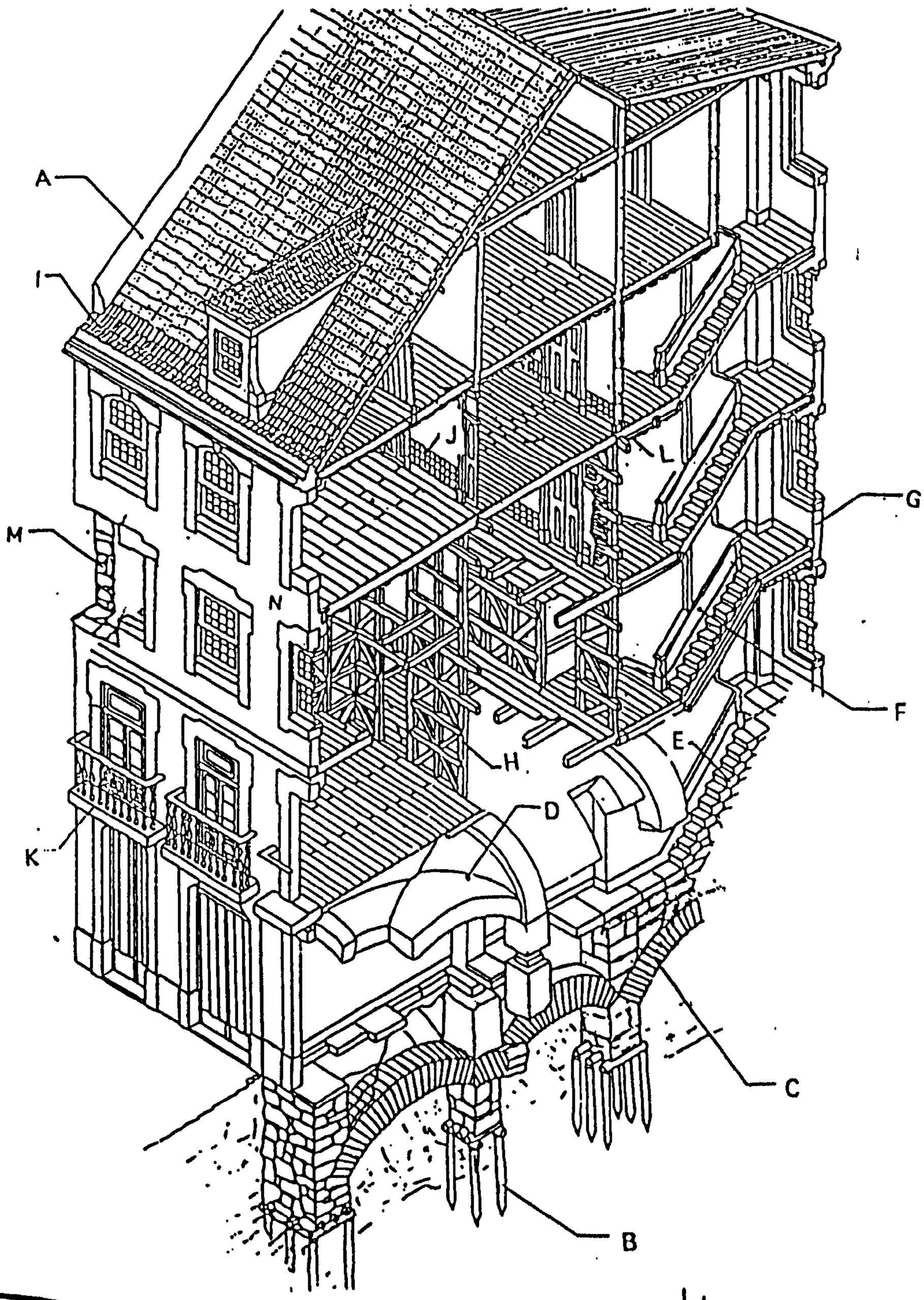


Fig.219-Isometric showing construction (drawing made from 110, S. Julião Street).

network of connections so that its elasticity would absorb the vibrations. It also allowed the internal walls to be of low mass. The introduction of such a system facilitated rapid construction of the superstructure(2). To reduce the risk of fire spread at ground floor level, in many buildings the "cage" was only built from the first floor up. For example of the nineteen buildings listed in Appendix 3 (p.46), 16 of the buildings were constructed in this way.

The exterior walls which formed the façades were much too heavy to adjust to earth movement, and it could have been self defeating to attempt to keep them intact and upright during a severe tremor since their weight could put the stability of the whole building at risk. Thus, that part of the cage structure which is adjacent to the external walls consists only of vertical and horizontal sections. This system allows the heavy walls to be released from the rest of the building, (Fig.220). The lintels and jamb stones of openings are tied to the cage with iron fixings (Fig.219 O).

Internally the gaiola panels were filled with irregular stones or pieces of bricks and mud, or just covered with wooden laths, to which wet clay was applied. In the event of an earthquake the plaster would disintegrate without harming the residents and the gaiola would retain its integrity and maintain its elasticity in resisting the earthquake, (Fig.221).

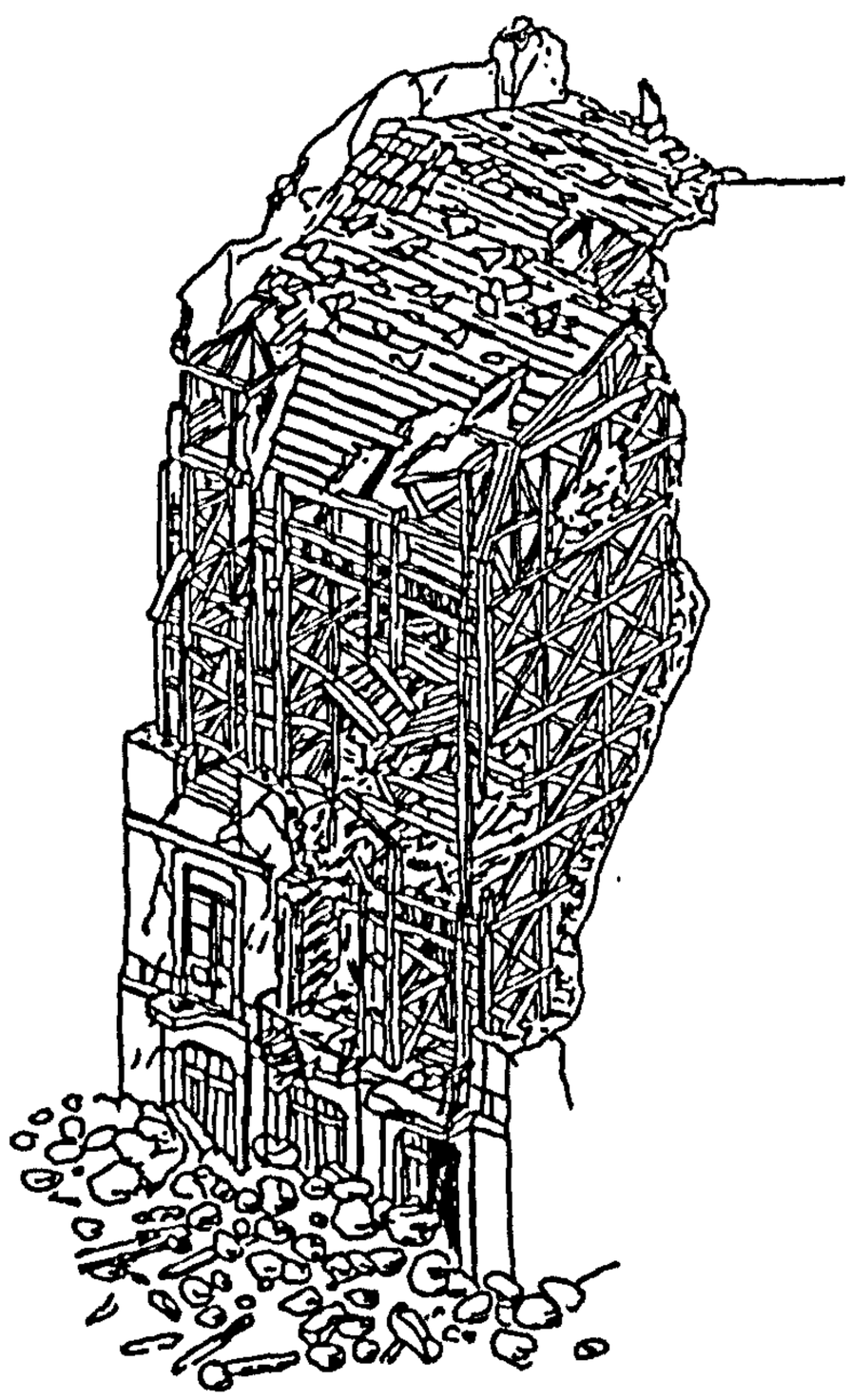


Fig.220-In event of an earthquake the façade walls would be released from the building

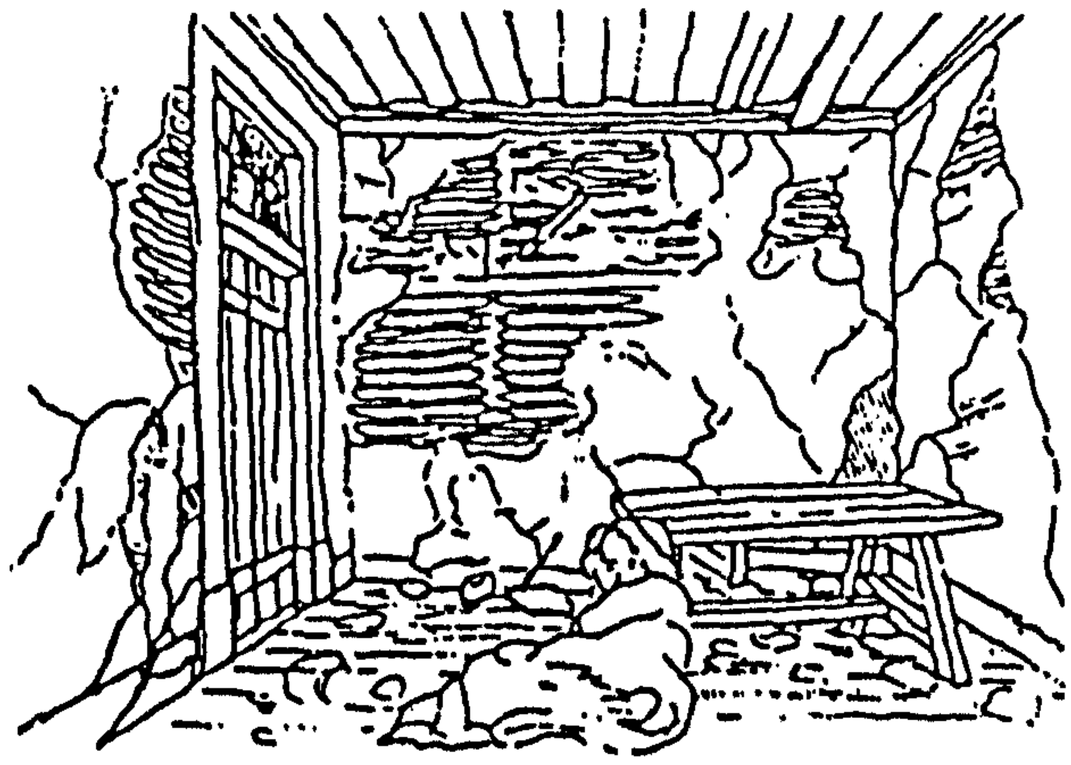


Fig.221-In event of an earthquake the gaiola would retain its integrity

Even today these buildings built with a wooden frame structure, and an earth and rubble façade are greatly admired for their elegance and basic simplicity and for their degree of perfection, (Fig.222).

Clearly the architects of the Pombaline quarter achieved technical innovations, which may be unique for this period(2, 30, 49).

The exteriors of the Pombaline buildings are protected by law, but their interiors and therefore much of their unique construction are not, and many of them have been altered beyond recognition. Action is needed now to protect those which remain.

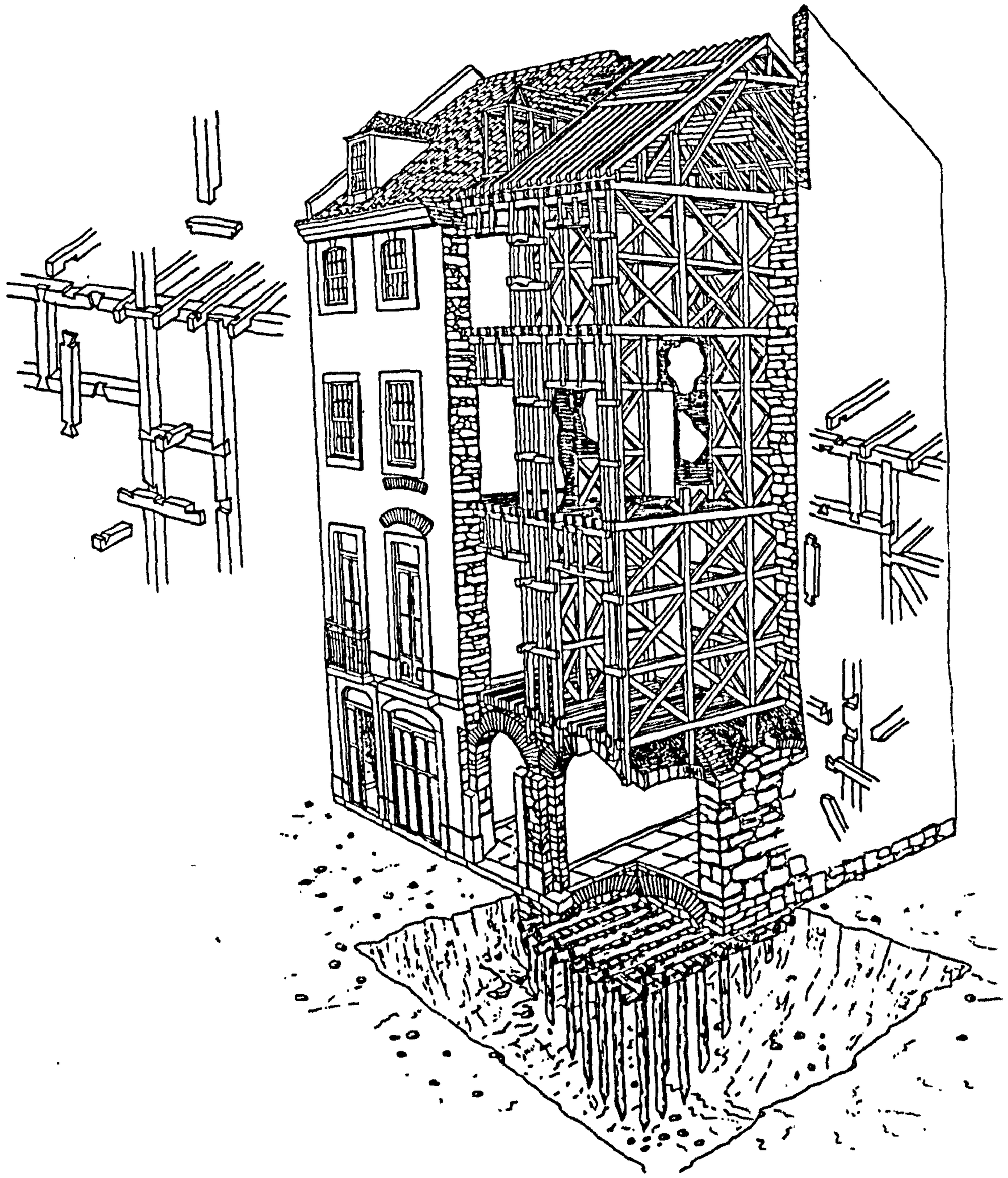


Fig.222-Isometric showing construction 2
(drawing made from 56-60, Ouro Street)

IV.2. Dimensional co-ordination and prefabrication.

Up to the time of the earthquake, the construction of buildings in Portugal tended to be highly protracted. As the work progressed, small workshops and specialised craftsmen would produce components to order[2]. However after the earthquake the urgent need to rehouse the inhabitants of a whole city demanded a new and revolutionary approach.

As already stated, the whole process of reconstruction followed strict principles of uniformity, simplicity and economy. Clearly the use of dimensional co-ordination would make the standardization and consequent pre-fabrication of the components easier, and there is substantial evidence that this was in fact the case [37].

IV.2.1. Dimensional co-ordination and the plan.

There appear in the approved plan (plan number 5, see section I.8.1) to be a number of rules of proportion underlying the standardisation, which are outlined below:

i)The *Rossio* Square is contained by a rectangle where the diagonal is the square root of five which is a rectangle formed from two equal squares, (Fig.223).

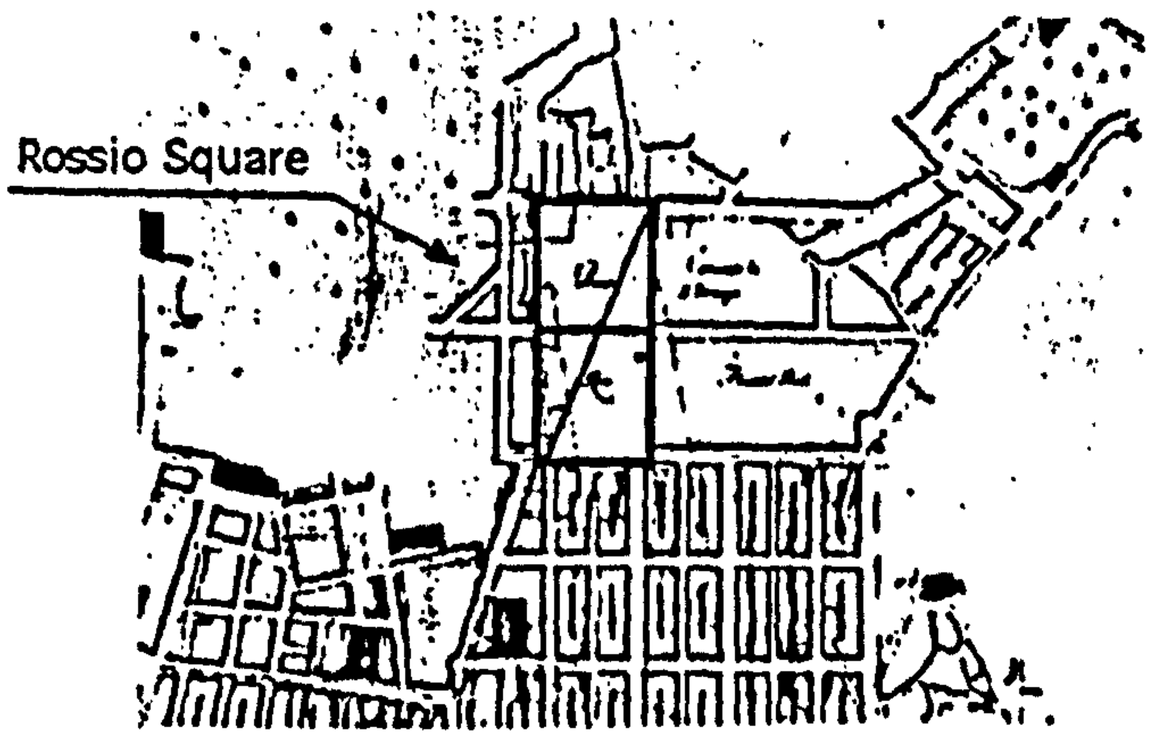


Fig.223-The *Rossio* Square and the V5.

ii)The main body of the planned reconstruction area, where the streets are all orthogonal is contained within a Golden Rectangle, (the sides are in the proportion of the Golden Number, 1.6180339..., see Fig.224). The peripheral region to the east in which blocks vary in size and shape and are not arranged in a regular repeat pattern, is probably a result of the fact that the area is one of difficult

topography, (see Figure 224 A) and also a church was reconstructed in the same position as that which it occupied before the earthquake, (see Figure 224 B).

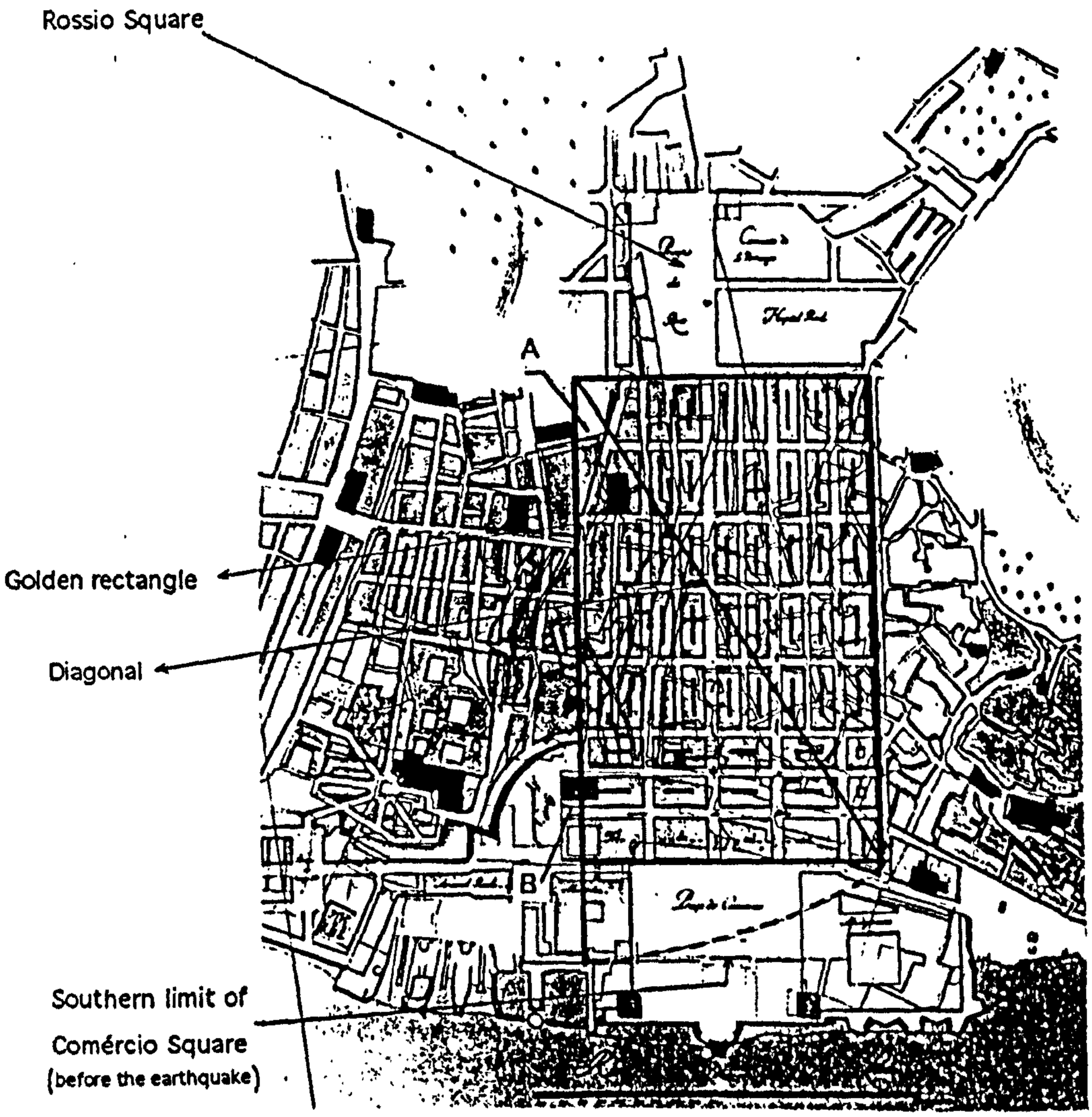


Fig.224-The golden section

iii)The dimension of the diagonal of the Golden Rectangle is the same as the distance, from the Rossio Square to the Southern limit of Comércio Square before the earthquake (see Fig.224).

iv)It is possible to establish a chain of three Golden Rectangles, within the principal Golden Rectangle, (see Fig.225). Two consist of two rows of blocks running N-S and one consists of one row of blocks running N-S and two rows of blocks running E-W. The diagonal of the large rectangle formed by the three small golden rectangles also defines the Southern limit of the blocks and the Nothern limit of Comércio Square.

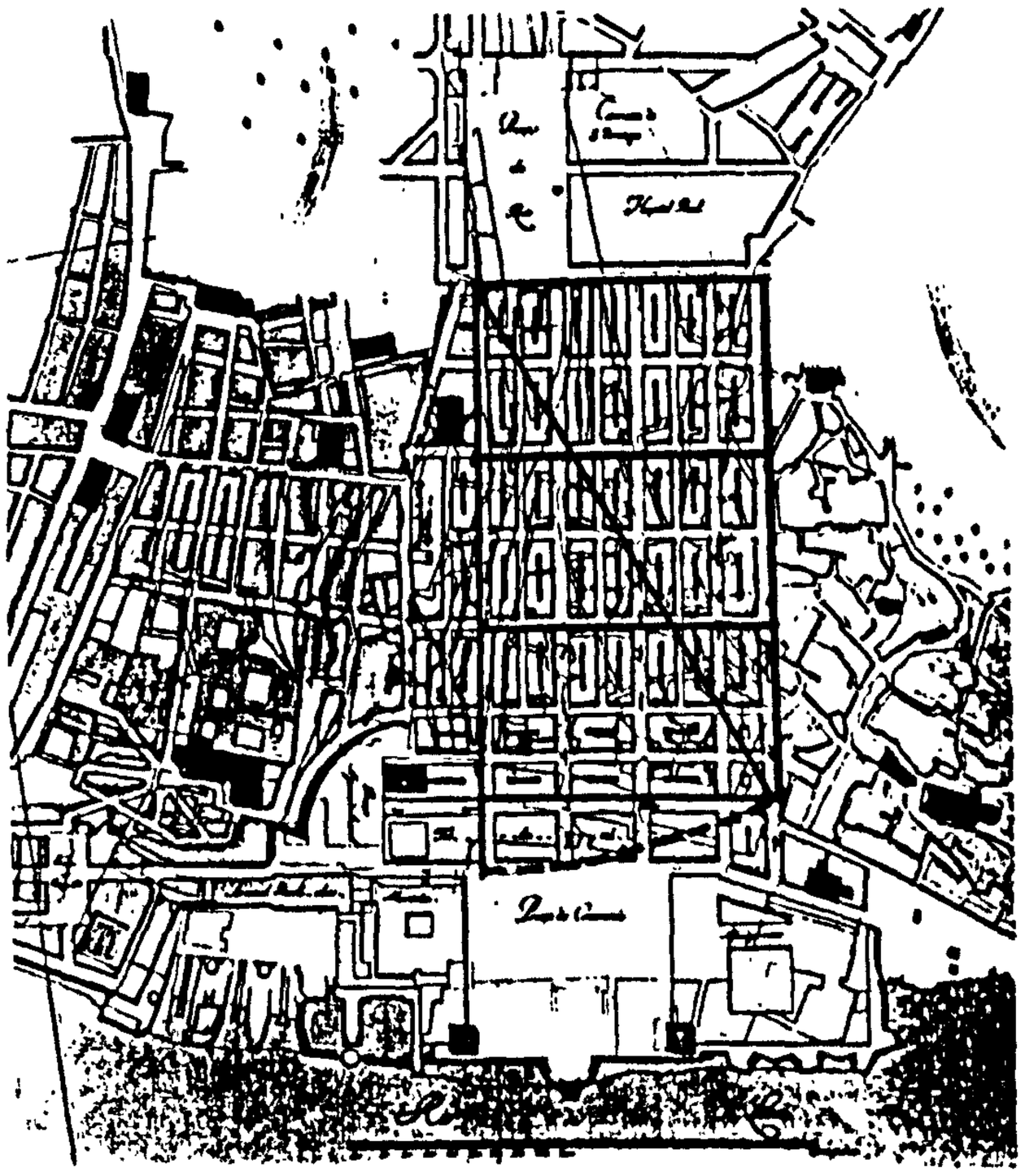
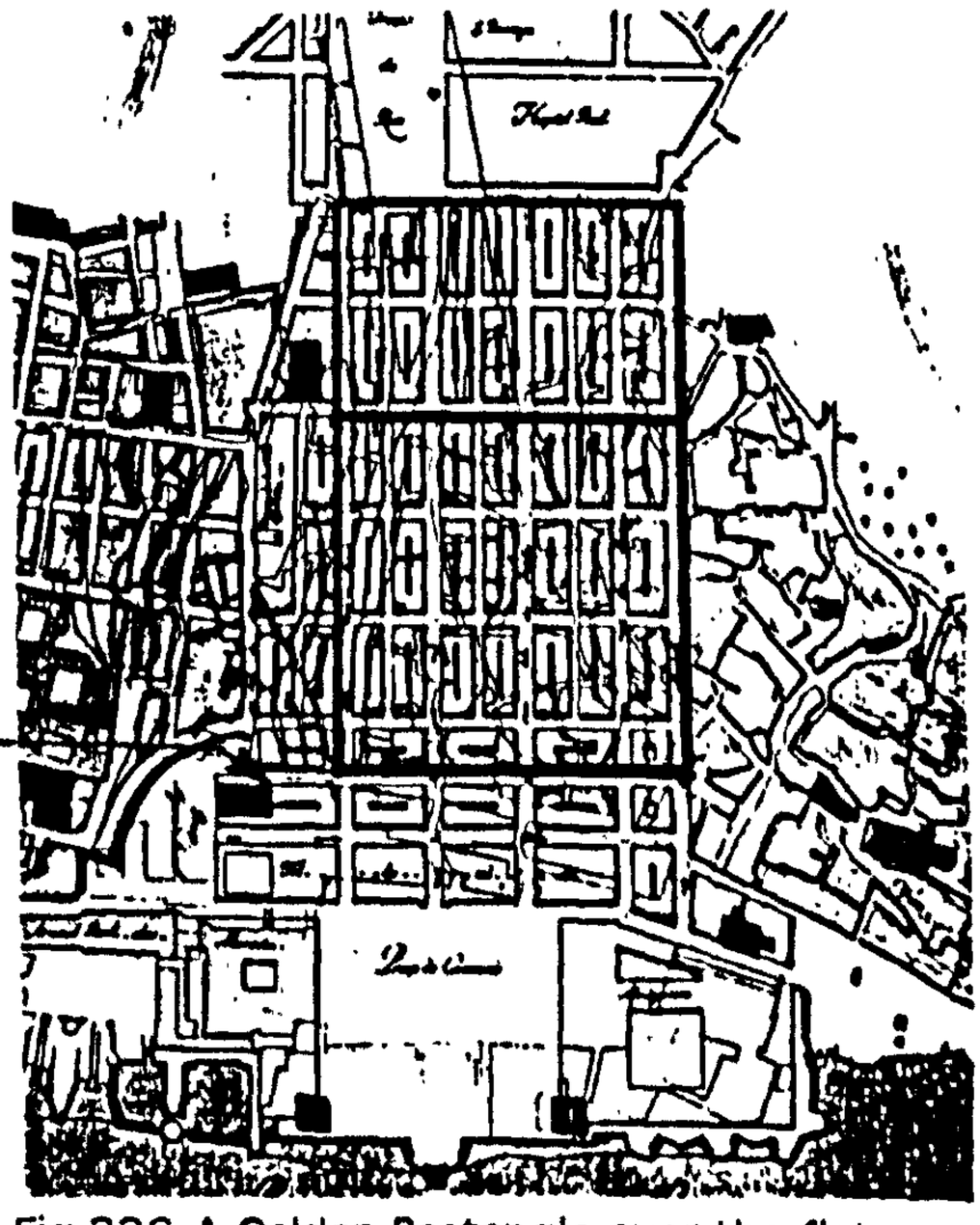


Fig.225-The chain of Golden Rectangles

v)In addition the flat area from Rossio Square to Old Ferros Street, (the main important street before the earthquake), also forms a Golden Rectangle, (see Fig.226), of which the upper two rows of blocks make up a further golden rectangle and the lower four blocks make up a square.



Old Ferros Street

Before the earthquake.

Fig.226-A Golden Rectangle over the flat area.

vi)The distance between Rossio and Comércio Squares is three times the dimension of a side of Comercio Square, (Fig.227).

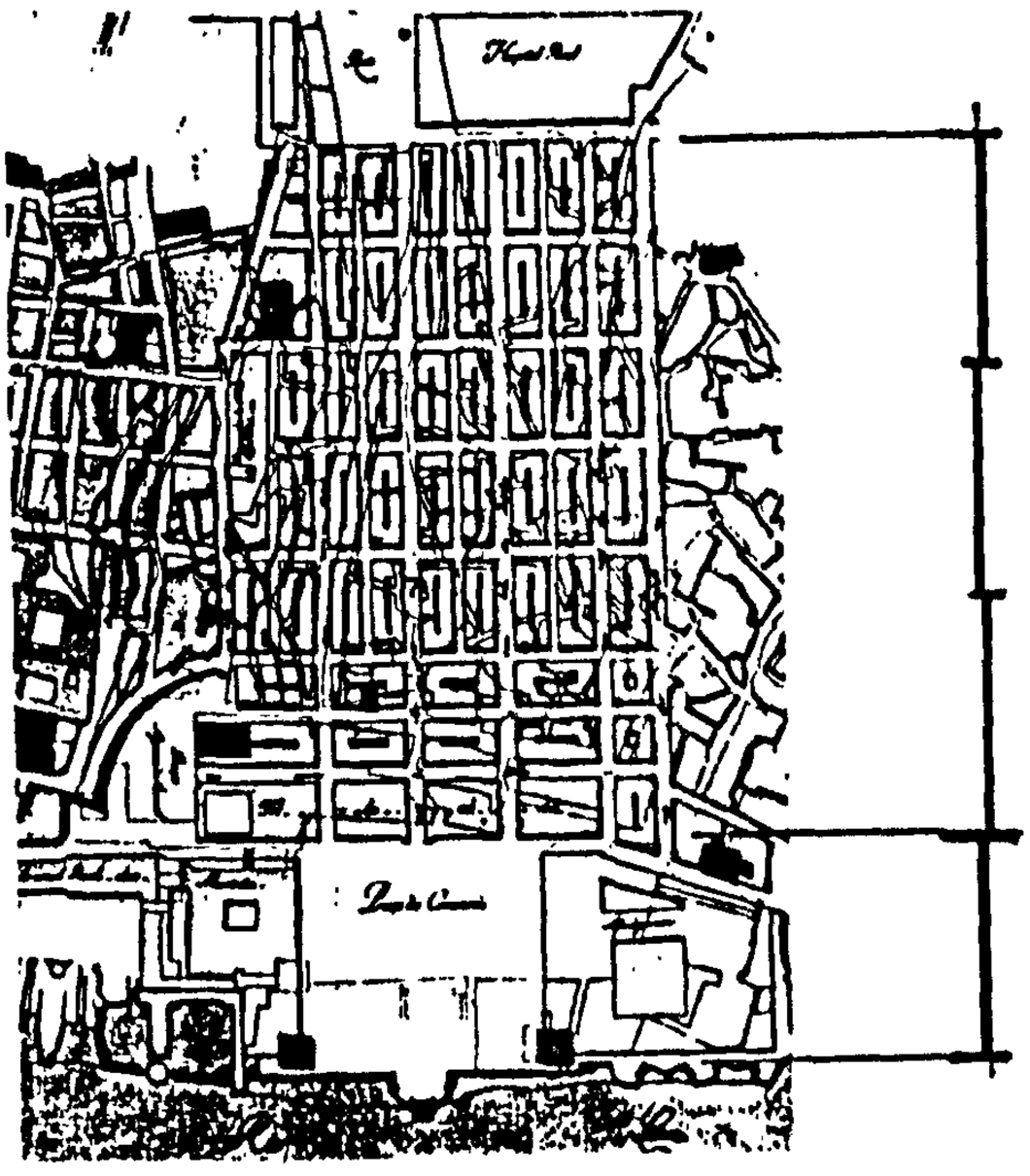


Fig.227-The established distance between Rossio and Comércio Square

From these examples it would appear that there was a basic underlying geometrical development to the creation of the urban plan and it is unlikely that these geometrical properties are a result of pure coincidence. It is likely that the dimensions of the golden rectangle defining the area of reconstruction was determined by the distance between the Southern limit of Rossio Square and the Nothern limit of Comércio Square, both of which were important squares prior to the earthquake. However it is impossible without additional information to understand the reasoning underlying the other geometrical properties and their relationships and any further interpretation would be pure speculation.

IV.2.2.Dimensional coordination and the facades

The Pombaline style, although normally seen as an undecorated façade which is very repetitive and relieved only by the corner pilasters, is in reality far from being monotonous, in the same way that constantly repeated shapes in nature are not monotonous but harmonious.

Geometrically regulated rules also appear to control the construction of the façades, giving them an equilibrium, rhythm and harmony which could adapt to the needs of the construction process and the division of property. The design of the façades is developed from a basic unit of exactly twelve palms in width, that is, the width of one window, and two half-portions of masonry on either side of it. Each façade comprises a whole

number of these basic units.

It is possible to identify geometrical development of the basic unit from drawings of the façade by Eugénio dos Santos, (number112 of the " Lisbon and Marquis of Pombal" catalogue (21)). The following are some examples of rules which can be deduced from these drawings.

i)The heights of the floors could be established from the diagonal of a square, the side of which has the same dimension as the façade modulation (see Fig.228).

ii)Two modulations are established from a diagonal of a square, the side of which is the same as the height of a floor, (Fig.229)

iii)By taking the upper and lower edges of the dressed stone window surrounds, and the centre lines of the masonry portions between the windows, a square is established the diagonal of which is also the height between the lower edges of the stone window surrounds on succeeding floors, (Fig.230).

iv)The dimensions of window surrounds, windows and dormer windows are established in a similar way, as are the heights of openings and spacings of door posts, (Fig.230).

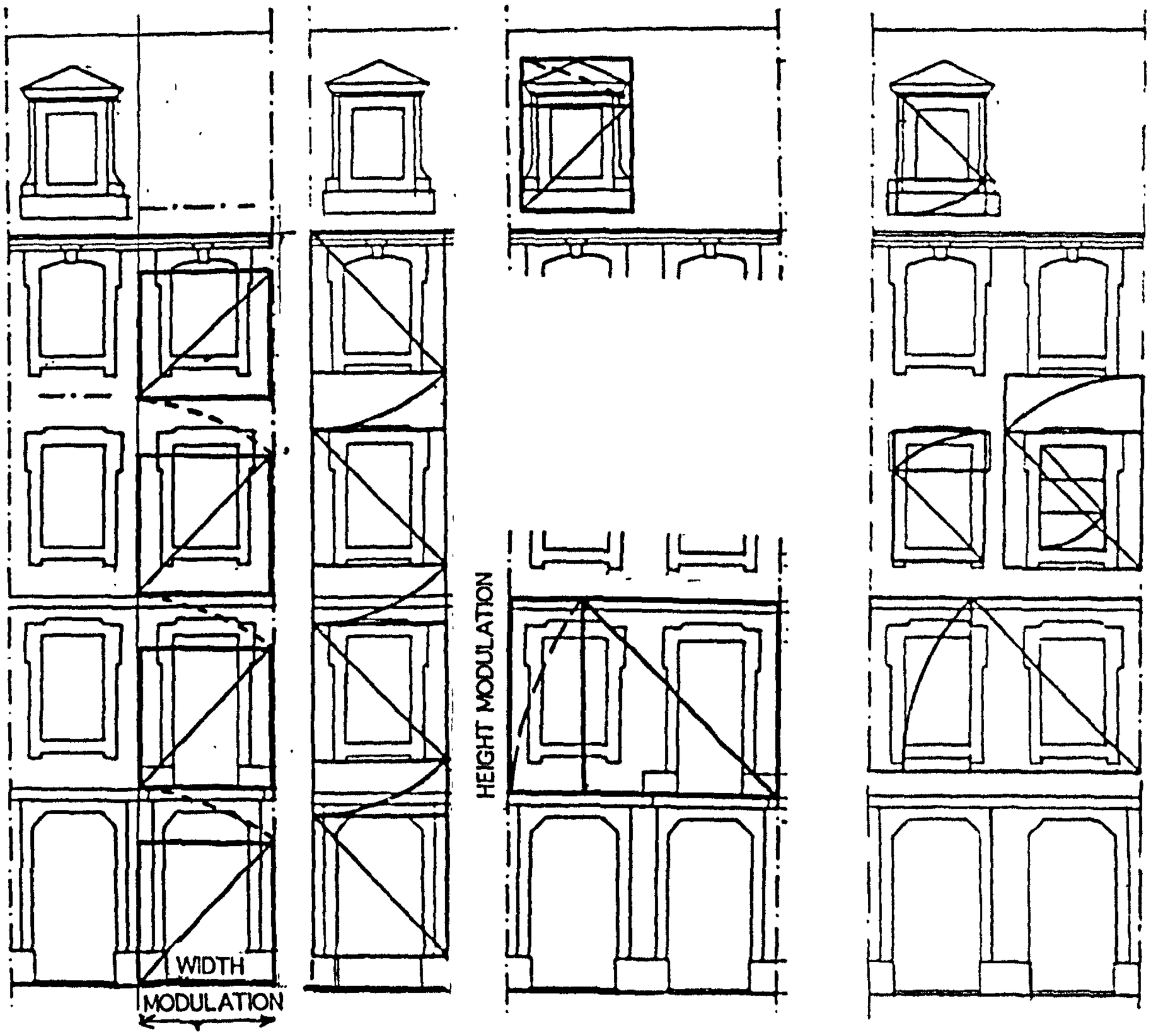


Fig.228-The heights established by diagonals of squares

Fig.229-Proportion between the height and two modulations

Fig.230-Establishing the stone window surrounds

The palm, an anthropometrically based unit, can from the evidence available, be shown to be the basis of all the designs undertaken in the rebuilding of the Pombaline quarter.

For example the various dimensions that regulate the façades are, (Fig.231):

i)The height of the window sill above the floor, (four palms).

ii)The width between the outsides of the window surrounds, (six palms).

iii)The height of the window head above the floor, (12 palms).

iv)The floor to floor height (15 palms)

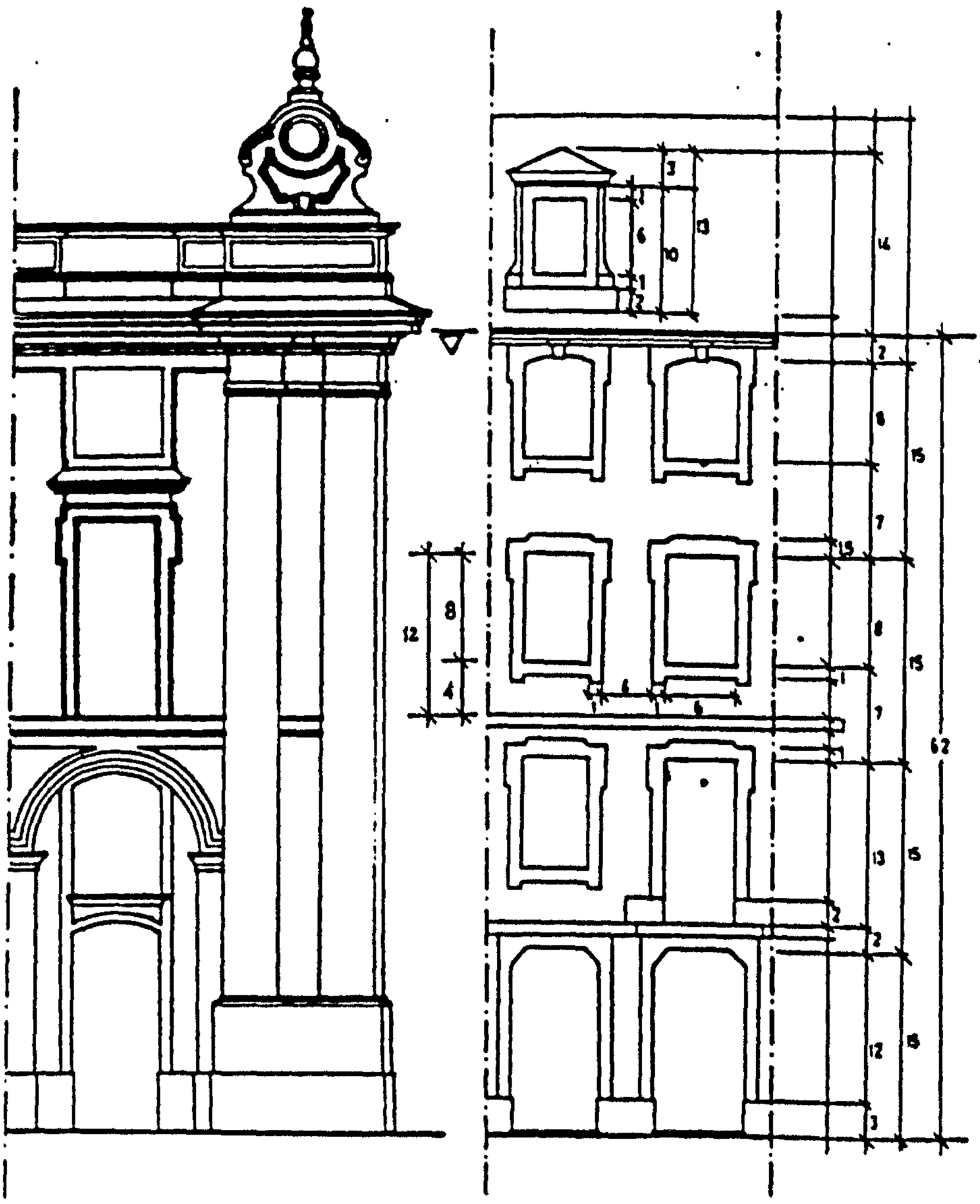


Fig.231-The palm used in the composition of the façades

IV.2.3. Dimensional coordination and internal spaces.

It can be deduced from the numerous plans which the author has produced, (see Appendix 5), that in the dimensioning of a working drawing of a building, a simple reference system was used which could co-ordinate the position and dimensions of all the elements. In this system the basic module, m, was a multiple of the palm, that is, four palms.

(m=4 palms= 4 x 22.5 cm = 90 cm)

For example, to make the fabrication and assembly of the timber frame sections easier, care was always taken to ensure that the vertical supports of the cage obeyed a strict system of modular dimensions, by which they were placed so that the dimension of a construction element, plus its joints and tolerances was always a multiple of m.

This is shown in the plan below, (Fig.232).

Alfugere

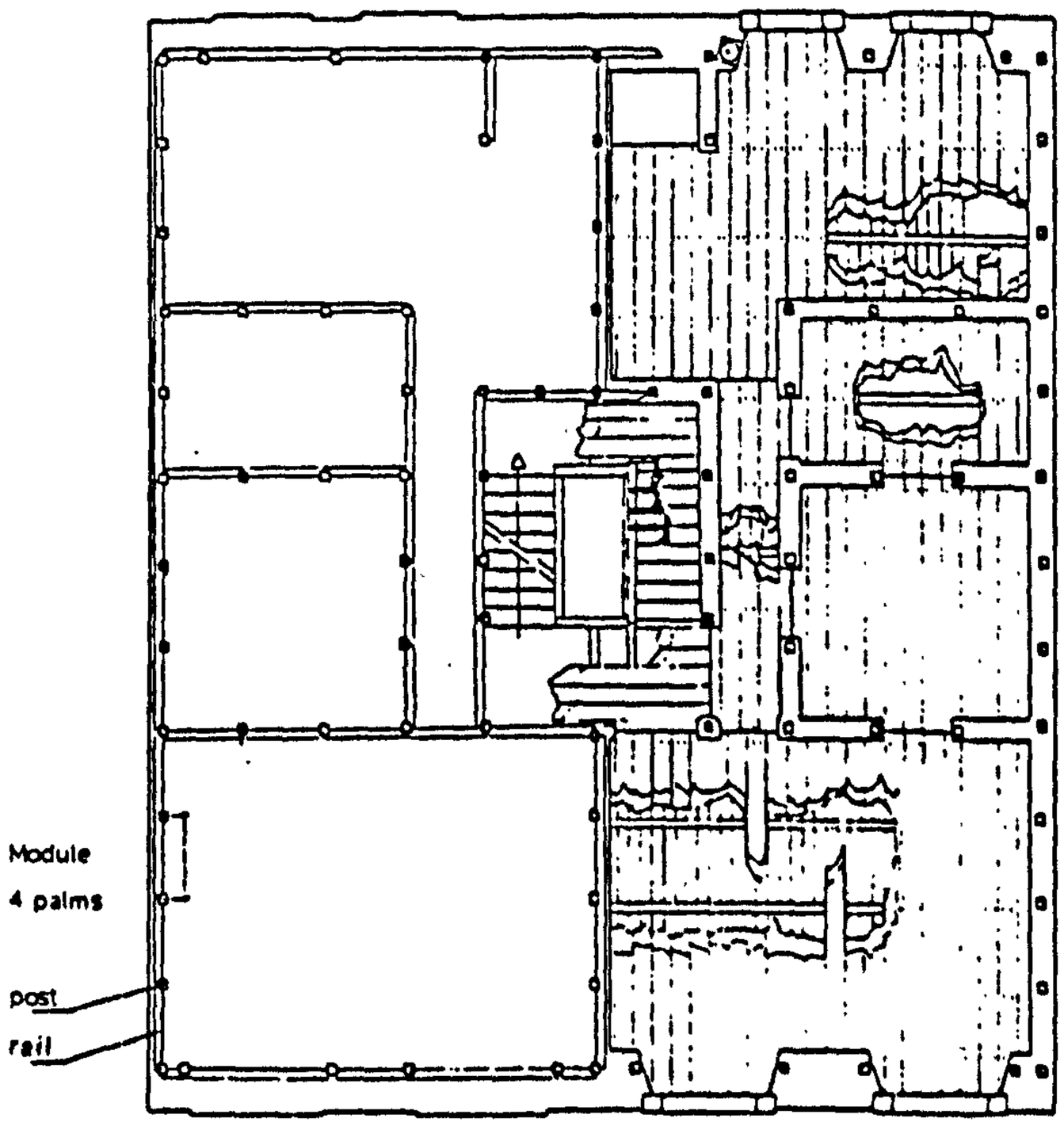


Fig.232-Modulation of the cage

Also as the width of a Pombaline building (plot) depends on the strict modulations of the façade, in the manner described in section IV.2.2., so its depth is related to its width by a similar set of well-defined rules of proportion. This is achieved even though units of different widths in the same block all have the same depth. The following examples of internal plans illustrate this principle:

i)The diagonal of the units with two *vãos* (spaces) in the façade is equal to the square root of 5 (Fig.233), and can be considered as consisting of two squares each of side length 24 palms.

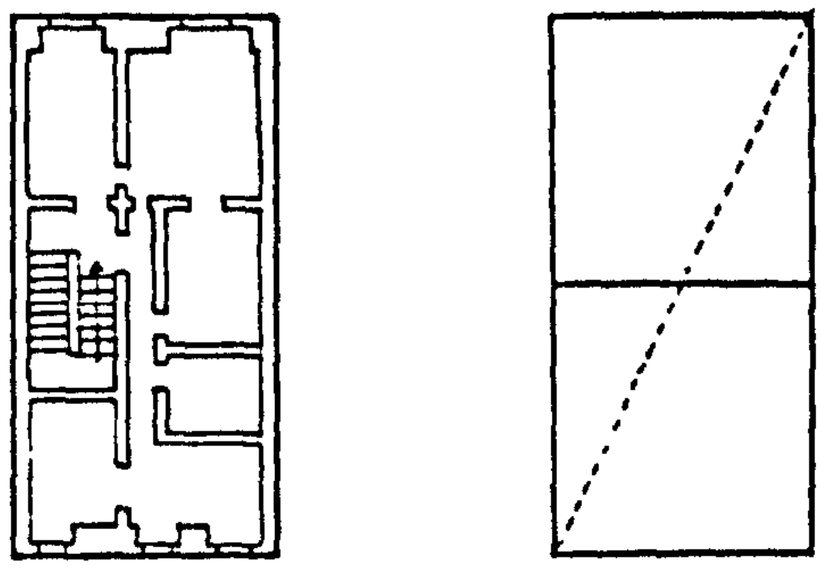


Fig.233-Plot with a width of two vãos.

ii)In the unit with three *vãos*, this produces a square, whose diagonal, the square root of 2, is equal to the depth, (Fig.234).

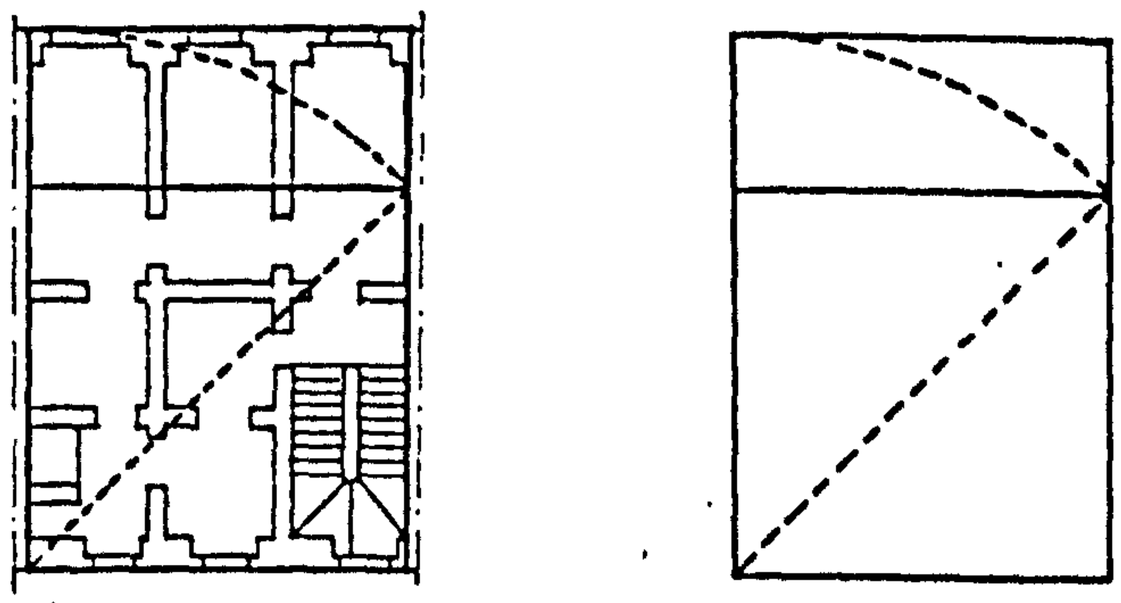


Fig.234-Plot with three spaces and square root of two

iii)Four *vãos* in the façade consequently result in a unit which has a square shape, (Fig.235).

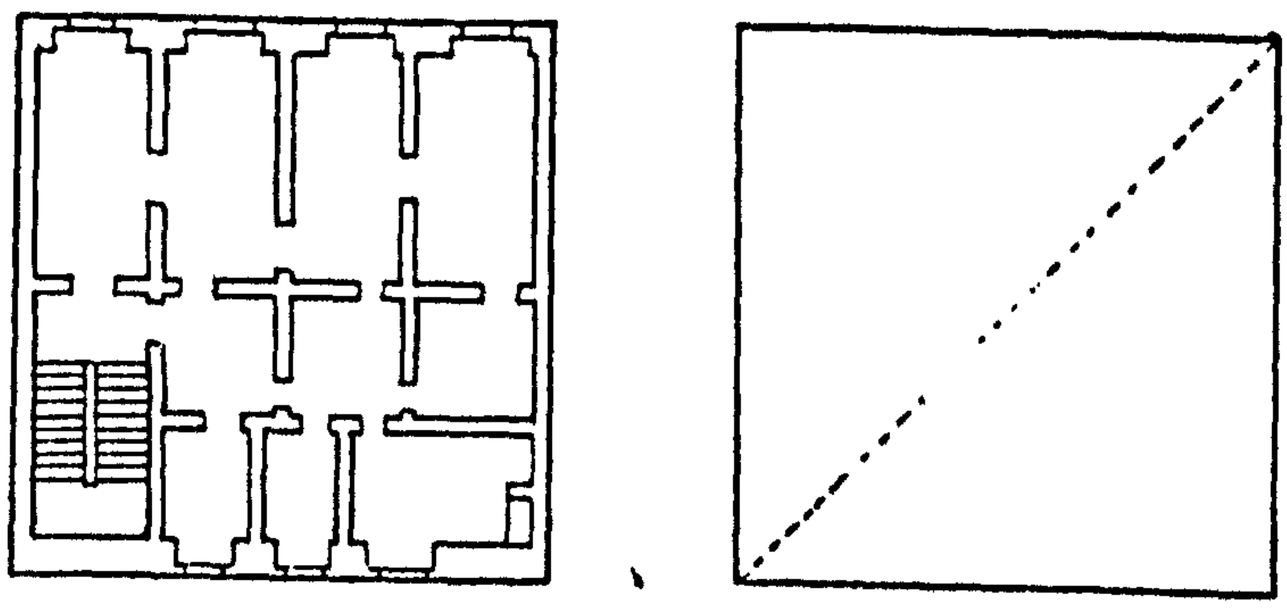


Fig.235-Unit with four spaces and square root of two

iv)In units with five spaces (vãos) in the façade the unit is nearly (1.625) equal to two golden rectangles (1.618), (Fig.236).

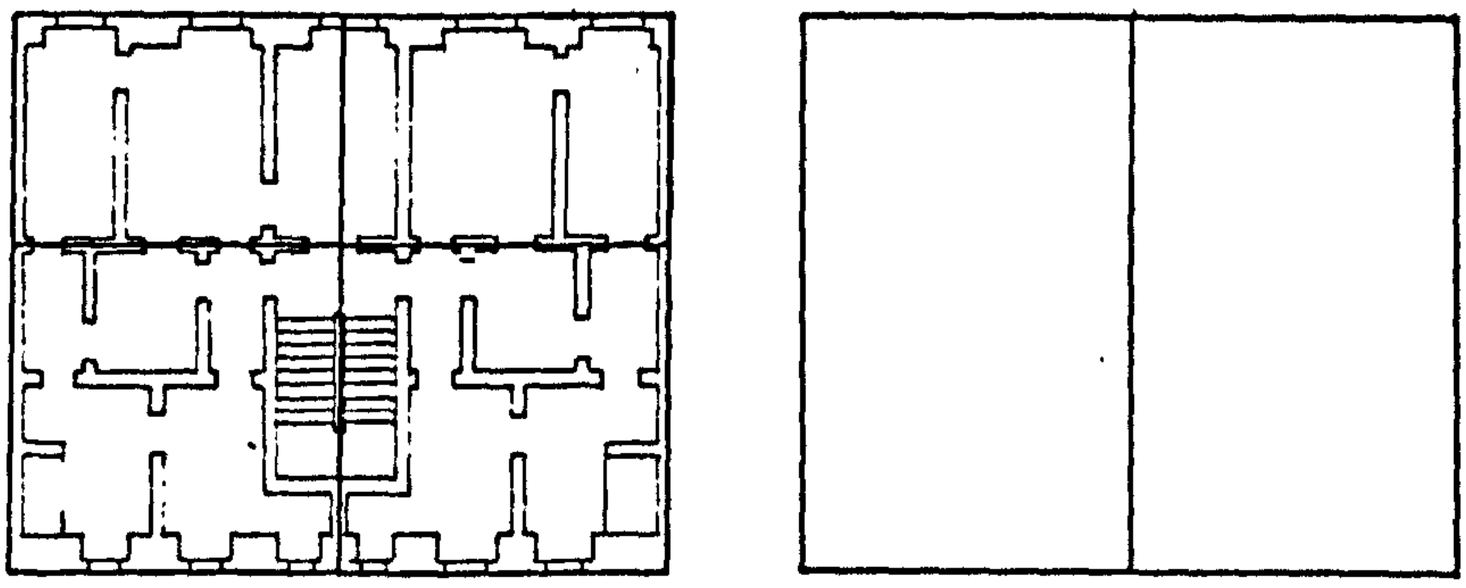


Fig.236-Unit with five spaces and two golden rectangles

The positions of the interior walls also appear to follow certain principles which produce particular geometrical properties.

The units within the Pombaline buildings always have a structure comprising three rows of rooms running parallel with the façade. The positions of the dividing walls are determined by the projections of the diagonals of defining squares or rectangles, this is illustrated in Figure 237.

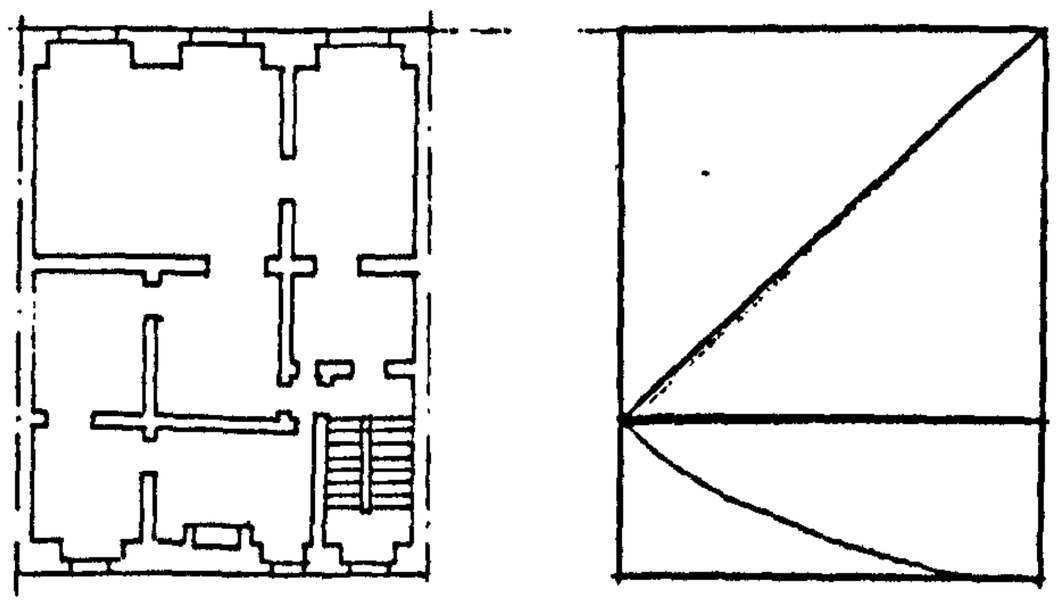
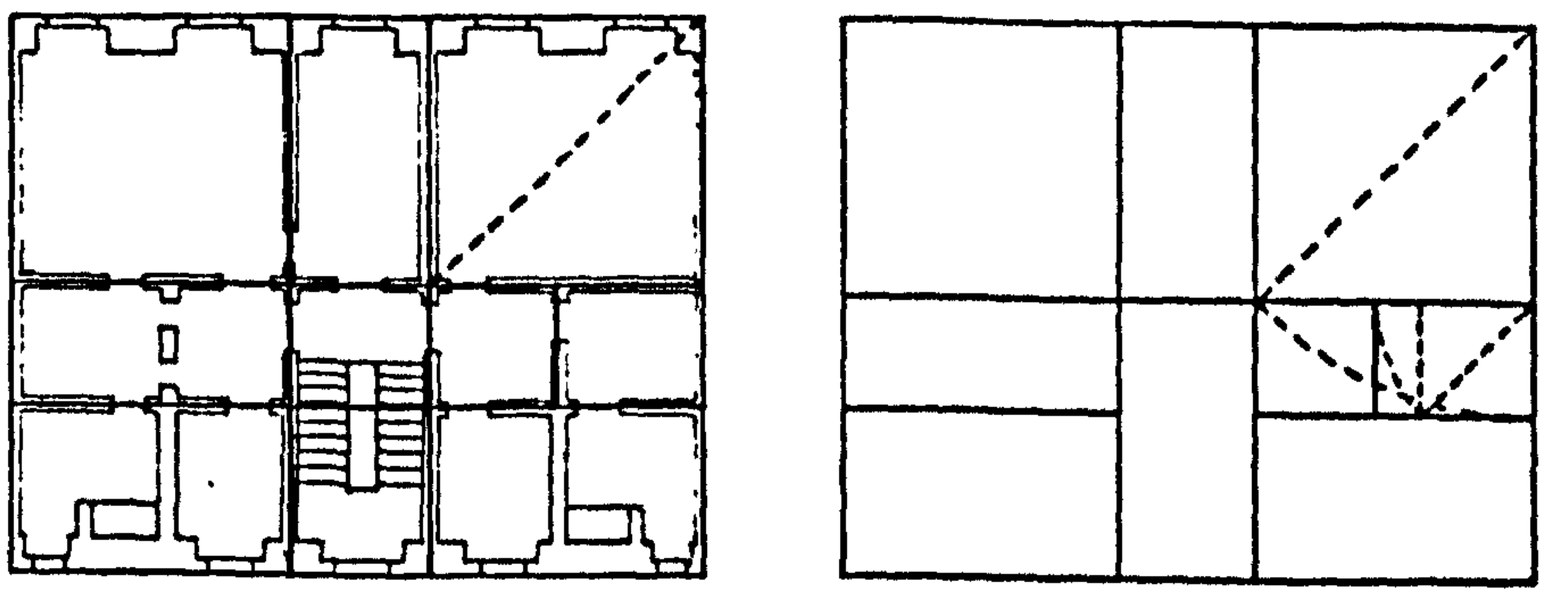


Fig.237-The diagonal of the rectangle determines the full depth: example 1 seven rooms.

In many cases the rooms immediately behind the street façade are based on squares and typically their diagonals give the depth of the front two rows of rooms, (Fig.238 and 239).



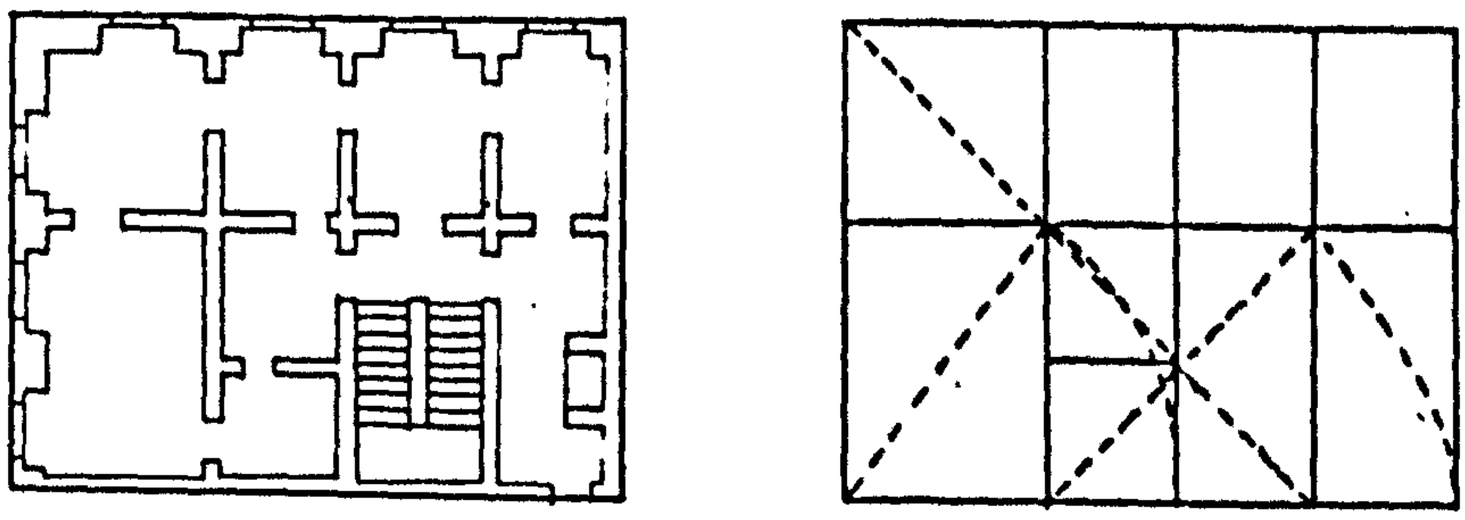


Fig.238-The square rooms behind the street façade define the depth of the second row of rooms: example 1

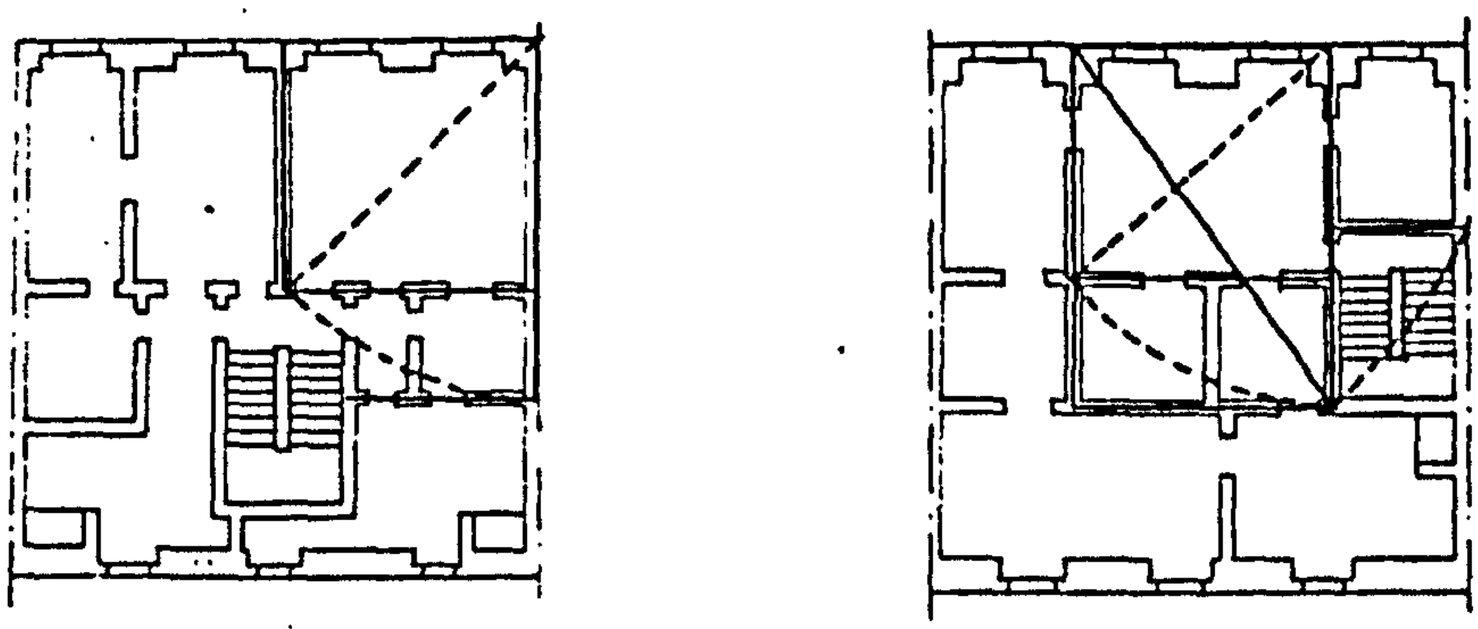


Fig.239-The square rooms behind the street façade define the depth of the second row of rooms: example 2

It is possible to discern from the plans of the rooms the existence of a modular grid in which each individual module is made up of a square or rectangle the dimensions of which are determined (see Figure 240) by the distance between the centre lines of the spaces between the windows on the façade.

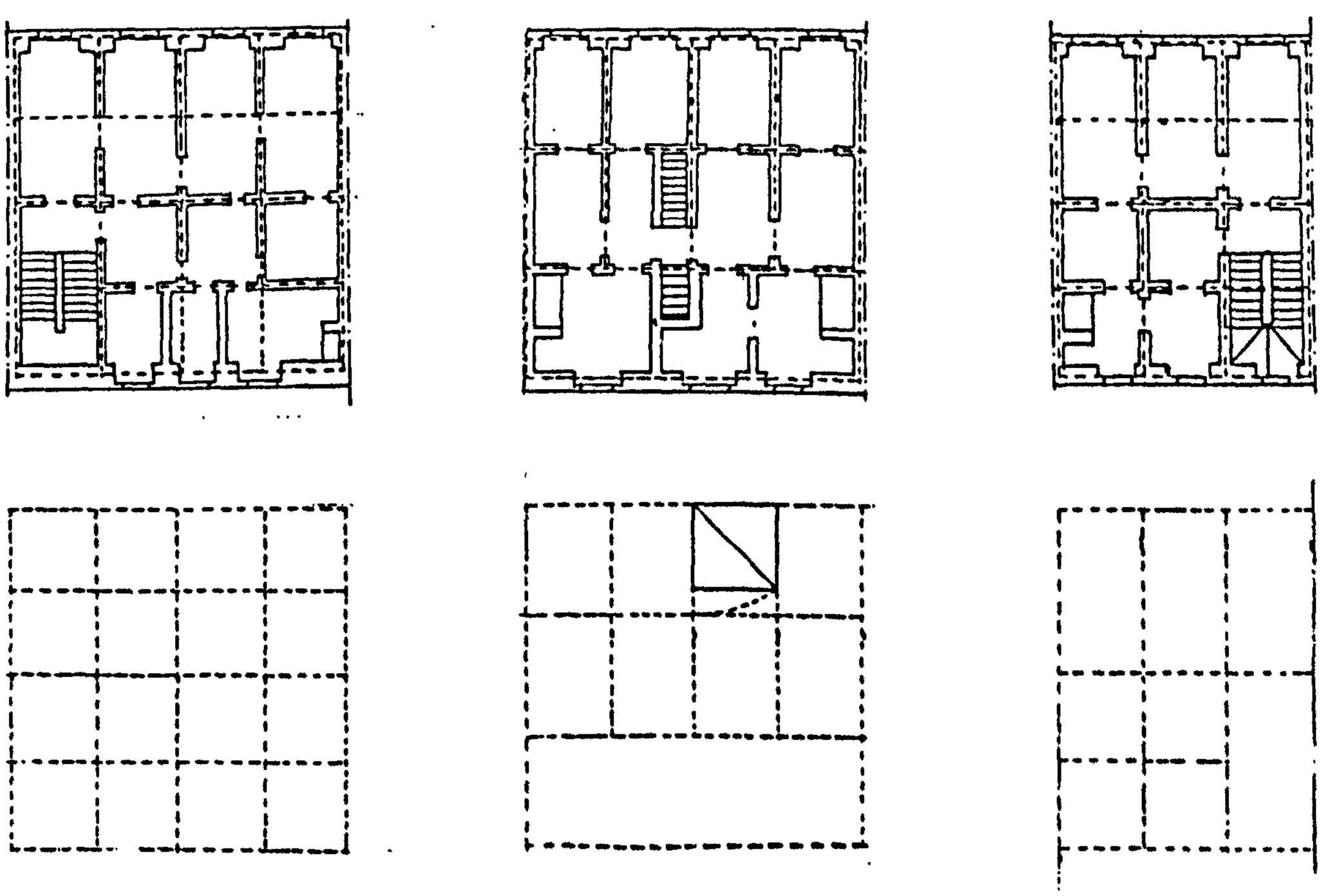


Fig.240-A modular grid

This therefore clearly establishes that the underlying principle on which the plans were devised was that of modulation. The modulation was achieved from the construction of a relatively small number of geometrical operations. These were repeated in various ways to build up the matrix of different rooms from an underlying grid pattern which was based on the repeat distance between spaces in the façade.

IV.2.4. Prefabrication.

To answer the need to rebuild the city quickly, at a time when the production of components in the capital was small and there was a shortage of specialised labour, França (2) and the late Portuguese Architect Porfirio Pardal Monteiro (40) have both suggested that a decision was made to turn to prefabrication and mass production.

These suggestions were no doubt influenced by the repetitive and standardised nature of the buildings. They incorporated a great number of pre-conceived elements such as dressed stone, joinery items, pillars, beams, props, tiles, rods, doorposts, stairs, etc., which were multiplied over and over again, without any variation, and which produced buildings of great uniformity in architectural and constructional terms. This is clear from the records of the observations made by the author of a large number of these buildings, (see Appendix 3). The suggestion is further supported by information passed down by the ancestors of architect Porfírio Pardal Monteiro, who was involved in the reconstruction or alterations of some of the Pombaline buildings, during his professional life. He claimed from his observations and knowledge that prefabrication had been used in the construction of the buildings (40) but he did not provide documentary evidence of this. The author contacted his nephew António Pardal Monteiro (see letter in Appendix 4.6) to ask whether the family had any past documents relating to the Pombaline buildings and prefabrication. The reply was that the family does not possess such documents but, they are sure from oral tradition and from analysis of the buildings by Porfírio during the alterations that prefabrication was involved. However there is no documentary evidence to prove this.

Prefabrication of building components was not unknown elsewhere at the time of the earthquake. The idea of using prefabrication for the rebuilding of Lisbon is thought to have come from wooden huts which were imported from Holland immediately after the earthquake, to provide temporary accommodation for the inhabitants whose homes had been destroyed. The huts were sent by boat and were easy to erect and to stabilise with gypsum plaster(2). British accounts of the earthquake state that the hut components were sent by sea and could be erected in twenty four hours, and dismantled and re-erected just as quickly (17).

It is also known that in the years immediately following the earthquake, the King and the Marquis of Pombal took measures to encourage the mass production and stockpiling of building materials and manufactured items in order to avoid speculation. A decree passed on the 15th May 1756 (31)states that "given the serious shortage of wood, roof tiles and bricks, and in order to facilitate the rebuilding of properties, all the materials and merchandise produced in the country's

factories could rightfully be brought into or out of the country without embargoes or debts, this has been conceded to products of the Grão Para and Maranhão Companies".

The decree of 12th May, 1757 (31), also more specifically encourages manufacture of materials and components. "As king, I hereby declare this licence to be lawful, considering it's utility, being for the rebuilding of the City of Lisbon, the multiplication of the factories of lime, bricks, wood and stone, and to ensure an abundance of these materials at fair prices. Reason and experience show that duties and coercion discourage all those who produce and transport the above mentioned materials... in order to prevent intermediaries and speculators, fabrication, transportation and competition are to be promoted.... I establish that with the desired duplication, no longer may anyone embargo or prejudice those who fabricate or order to be fabricated, transport or order to be transported...".

The references to "factories of wood and stone", "desired duplication". and "fabrication" in relation to wood and stone, suggest that mass prefabrication of wood and stone components was envisaged, as opposed to mere extraction and processing of the materials.

An edict of 29th June, 1757 (31) states "His Majesty, considering it to be in the public´s interest and for the benefit of residents and manufacturers that prices be maintained, ...the treasury should proceed to purchase all materials produced in the Kingdom that do not find immediate buyers and should stock up, supplying when necessary at the price at which they were bought... Anybody may deliver the above mentioned materials to the Rua Nova do Arsenal (Arsenal Street) where their right price will be paid and where also these materials will be sold at the right price to those who need them, in small or large quantities, to carry out their building work". The reference here is to materials, but the Portuguese word would not exclude manufactured components.

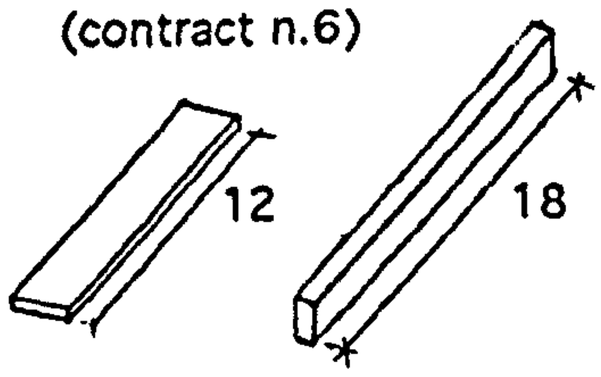
A search has been made for documents contemporary with the rebuilding which would confirm the oral tradition about prefabrication and the effect of the government measures described above (16, 51). Unfortunately many documents have been destroyed by a fire in the main Lisbon archives (16), but building contracts have nevertheless been found relating to the period.

There were found by the author 13 building contracts between 1757 and 1790 (54). In 11 contracts the master mason is effectively the General Contractor, with responsibility for "all the works" including masonry, carpentry, joinery, ironmongery and "finishing" (presumably plastering and painting) (see Appendix 4.5). In both contracts translated in the Appendix, payment is to be in relatively large, infrequent instalments, with most of the payment being towards or at the end of the construction, after a complete inspection and measure of the work done. The general contractor was not merely a self-employed tradesman, but a businessman who

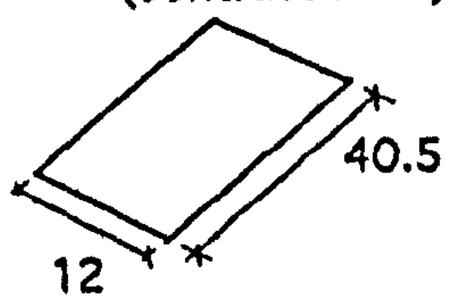
conducted a substantial operation and could raise substantial amounts of capital. In most cases the payment was made with the rents paid to the general contractor with a tax of 5% and in some cases with parts of the buildings, a shop or a flat. In one case payment was made with materials.

In view of this it would not be altogether surprising to find that the contractors were expected to obtain prefabricated, mass-produced components from already existing stock. The contracts included evidence suggesting this. They give dimensions in "palms" (22.5mm) as follows:

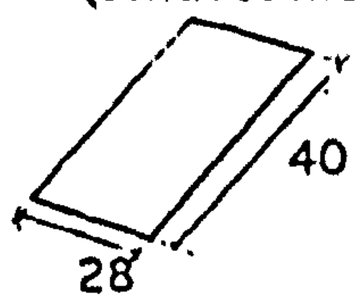
Boards and beams
(contract n.6)



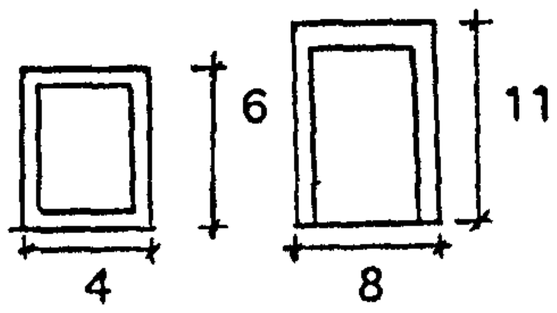
Building plan size
(contract n.12)



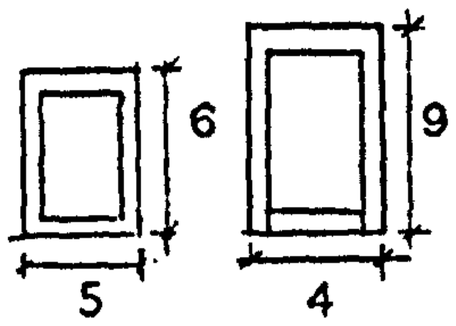
(contract n.6)



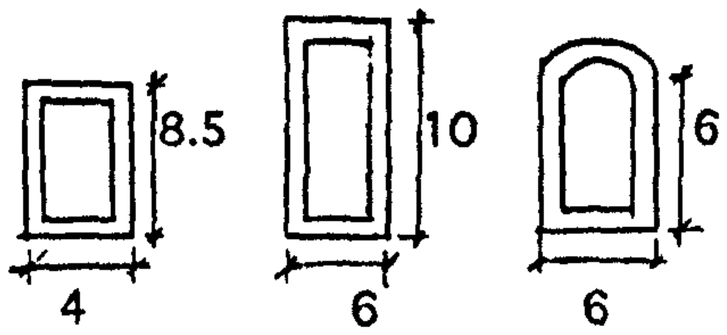
Doors and windows
(contract n.2)



(contract n.4)



(contract n.6)



In one contract (n.6) [55] it is stated that the stonework for the stairs, and the dormer windows must come from the Stock Exchange of the Terreiro do Paço. The Rua Nova do Arsenal leads from the Terreiro do Paço (Comércio Square), and hence it seems highly likely that the "Stock Exchange" referred to is in fact the stockpile of building materials established by the Treasury as a result of the edict of 1757, just over three years before the date of the n.6 contract (1760). If this is so then the stockpile contained prefabricated components such as windows and stonework for staircases, perhaps stone treads, and the incorporation of these components was facilitated by dimensional coordination based on the module of the palm.

The site of the building referred to in the n.6 contract has not been identified, but the description of the semicircular arches indicates that it was not in the Pombaline quarter itself. Neither was the building in the n.4 contract [56] referred to, but the latter was close to the Pombaline quarter in an area in which the design of the existing eighteenth century buildings is very similar to those of the Pombaline quarter itself. If prefabricated, mass-produced components from already existing stocks were being used for buildings outside the quarter, then it seems even more likely that they were used inside where the design of the buildings is even more repetitive and standardised.

The Pombaline buildings were not completely prefabricated - they included, for example substantial amounts of rubble stone walling - but they did incorporate many standardised and possibly prefabricated components, especially dressed stone and joinery items, the use of which relied on effective dimensional co-ordination. These components did not differ greatly from those which were already produced by craftsmen to order, and which can be seen in surviving buildings from before the earthquake such as Ludovice Palace. They were merely simplified and standardised in a way which would have accelerated their manufacture by mass production. They could then have been produced in an anonymous and abstract way in workshops scattered through the outskirts of the city as well as within it. Few workshops or factories from the period remain, except for a wall tile factory at Amoreiras, the Fabrica do Rato which is believed to have produced many ceramic wall tiles which were used in the reconstruction.

Observation of buildings in areas built before the earthquake suggest that symmetrical (Fig.241) and elaborate panel compositions (Fig.242), were in vogue. However these would be difficult to adapt to the simple repetitive style envisaged for the Pombaline buildings. Also the previous excessive use of material (Fig.243) would not be appropriate to the austere economic climate prevailing after the earthquake. Thus modulated simple repetitive compositions were adopted which were easy to adapt to different spaces.

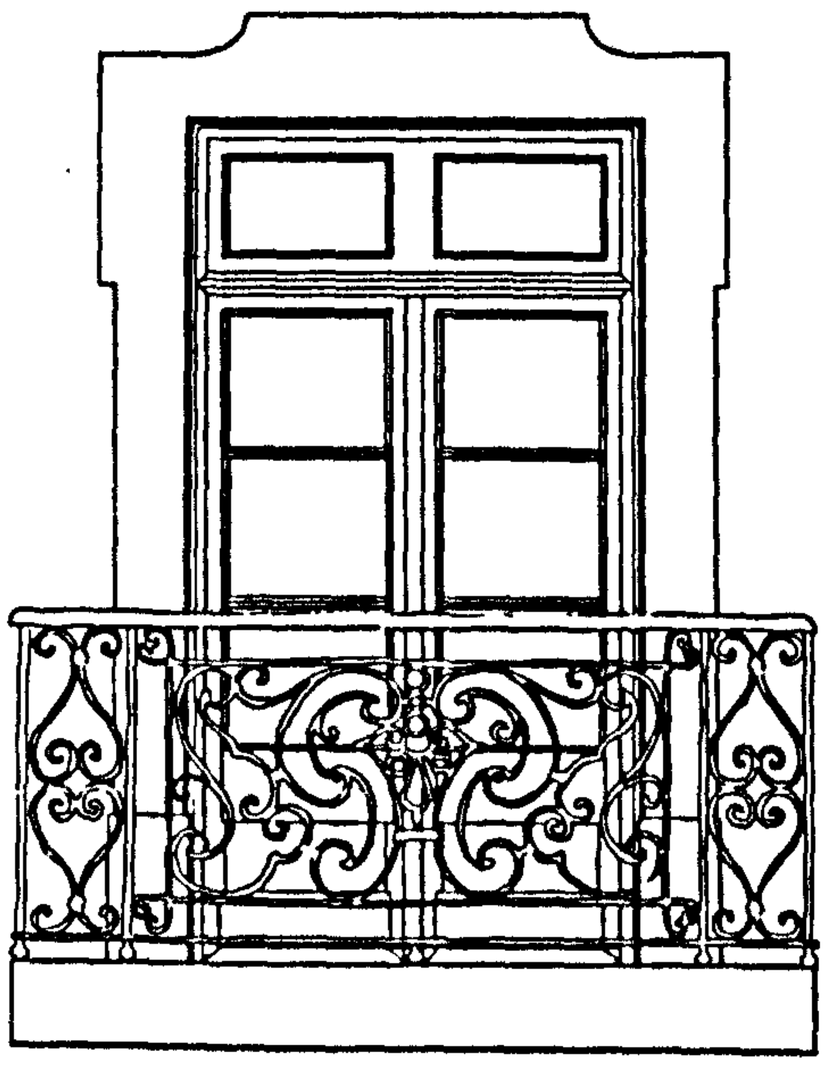


Fig.241-A symmetrical composition
Before the earthquake

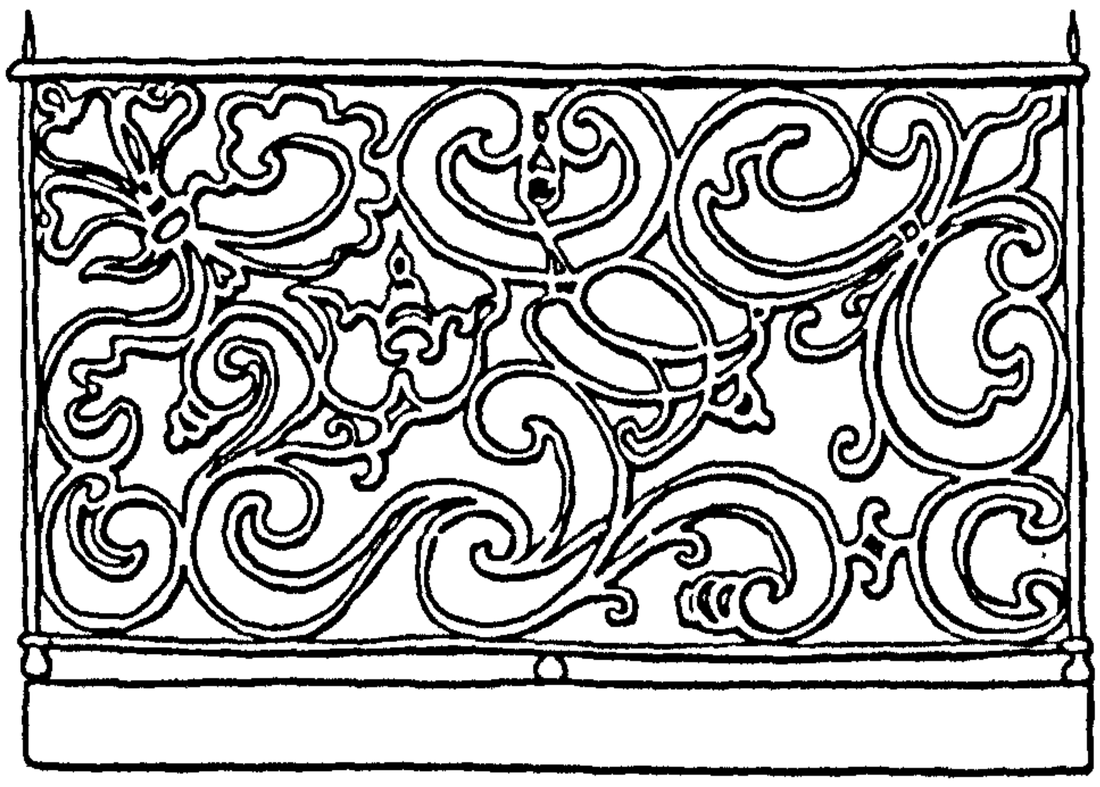


Fig.242-Panel composition
Before the earthquake

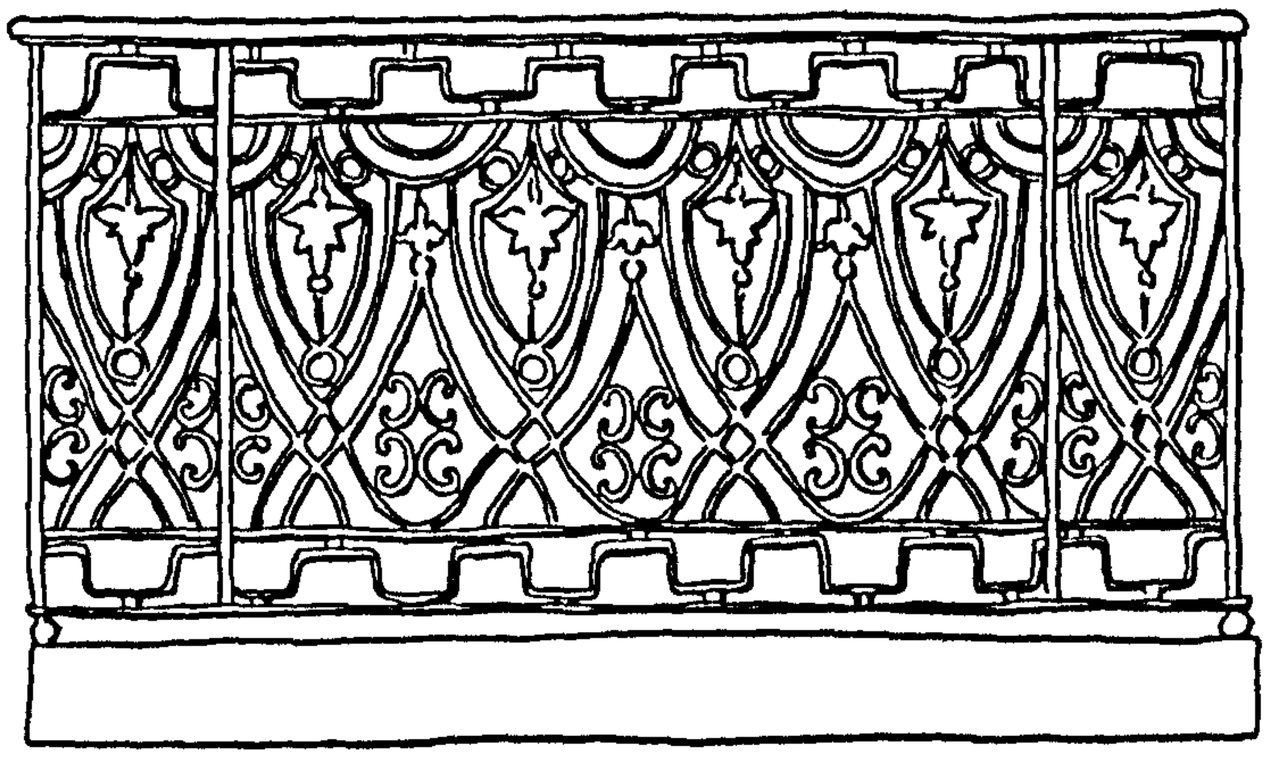


Fig.243-Components with excessive use of material, before the earthquake

A detailed study of external features and internal fittings and construction details of buildings by the author suggests that the standardization of the traditional components obeyed the following principles:

i)The number of variants adopted was small and there was a strong uniformity of components.

ii)Measurements and modulation for the manufacture of the traditional components were carefully selected, and those chosen were ones providing maximum flexibility and adaptability, (Fig.244).

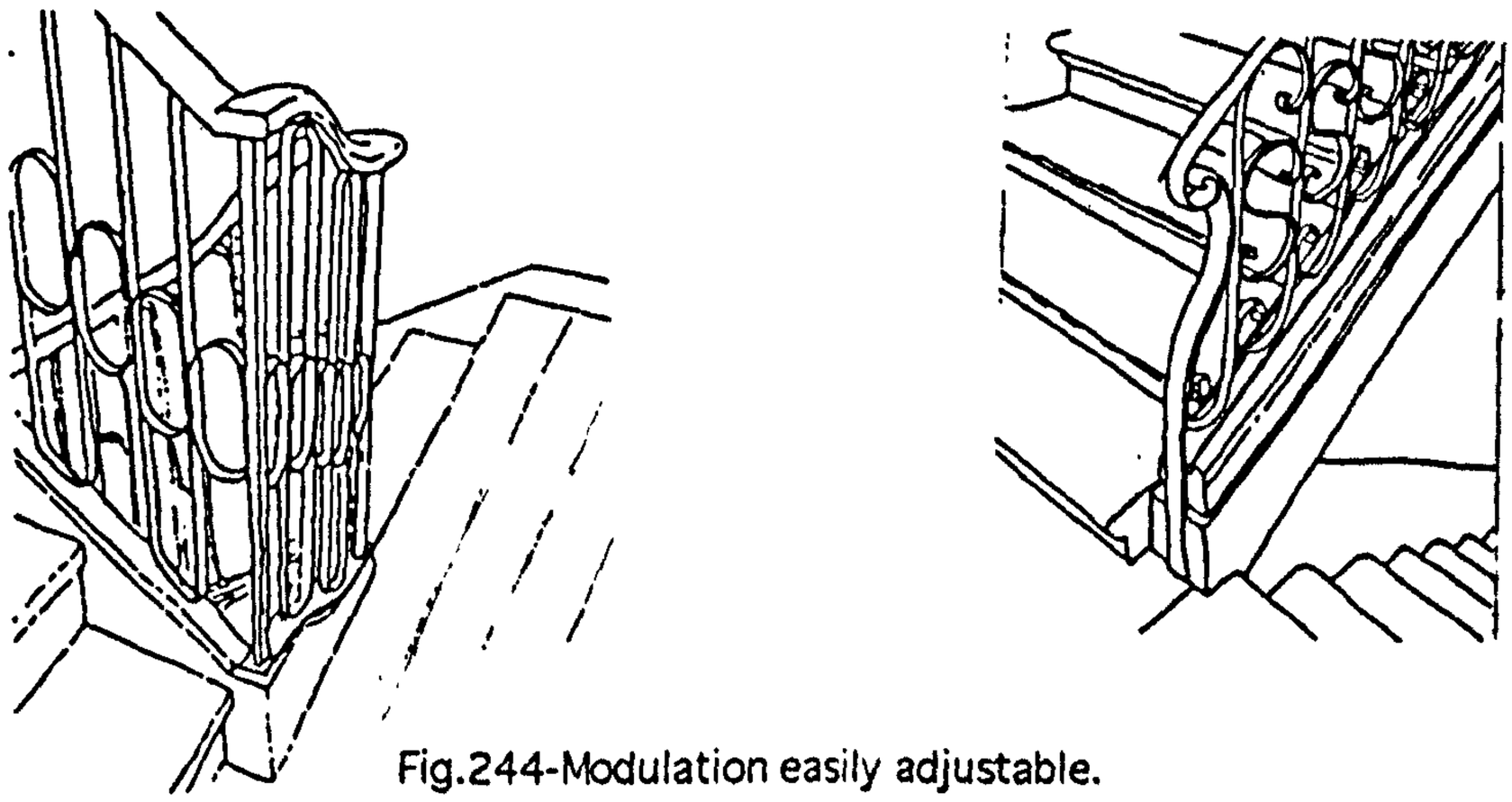


Fig.244-Modulation easily adjustable.

iii) The design of the components was simplified, and decorative elements were stylized or eliminated from them, in order to facilitate mass manufacture. For example, on the façades, the greatest degree of refinement was in the stonework of the windows, and this was achieved not with any rich decoration, but through a stylisation of forms, (Fig.245). The same happened with the railings of the balconies, the design of which was very simple, but highly effective, because of the proportions used.

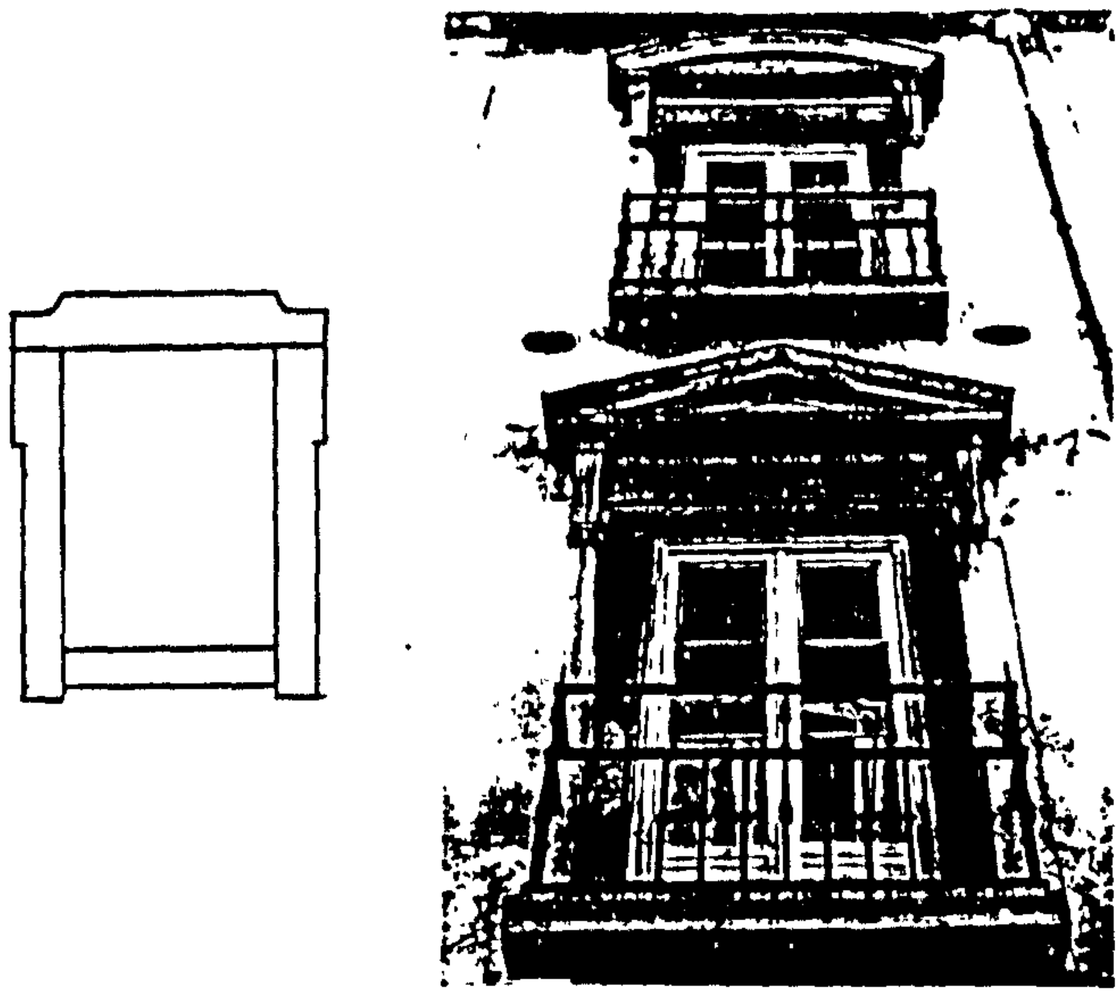


Fig.245-Simple and standard Pombaline composition and a complex composition

iv)In other cases attempts were made to substitute more elaborate elements, which had been common in the past, with others which were simpler to fabricate and assemble. For example, a railing along a stairwell could be substituted by a solid tiled balustrade, (Fig.246).

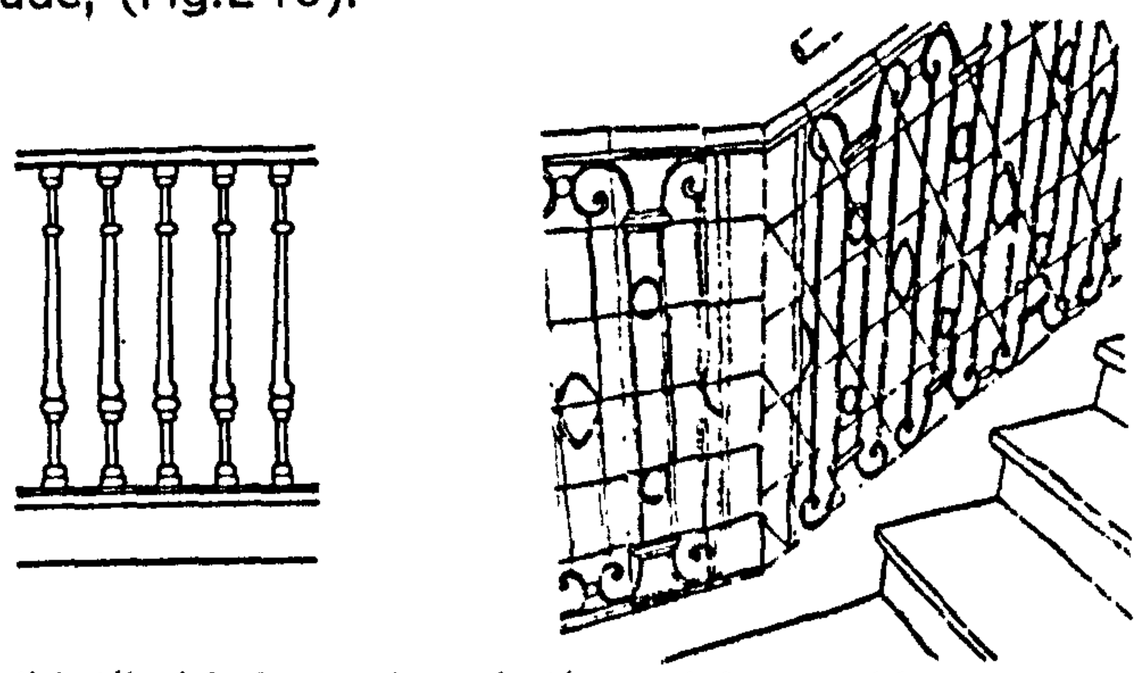


Fig.246-A solid, tiled balustrade substituted for a railing along a stair

v)The combination of modular components was easy to adapt to different dimensional situations. For example, the railings could be reduced or adapted easily during construction, (Fig.247).

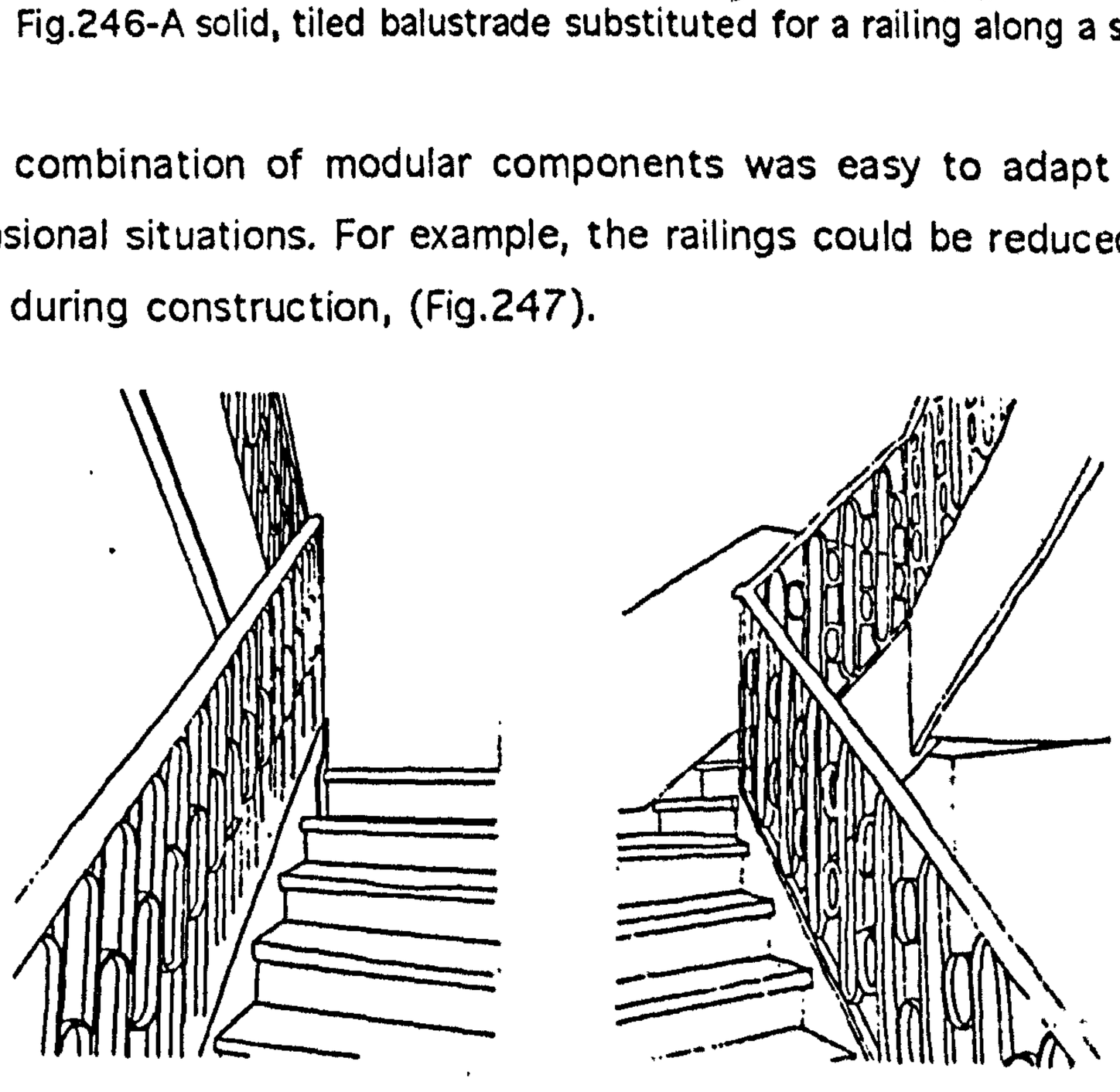


Fig.247-The easy adaptation of components to different dimensions

vi)Modulation of elements was conceived in such a manner that they could be used for different functions, or in various forms. As we can see the designs of the patterns for the metal railings were so simple in composition that they could be used in any situation for steps or balconies, (Fig.248).

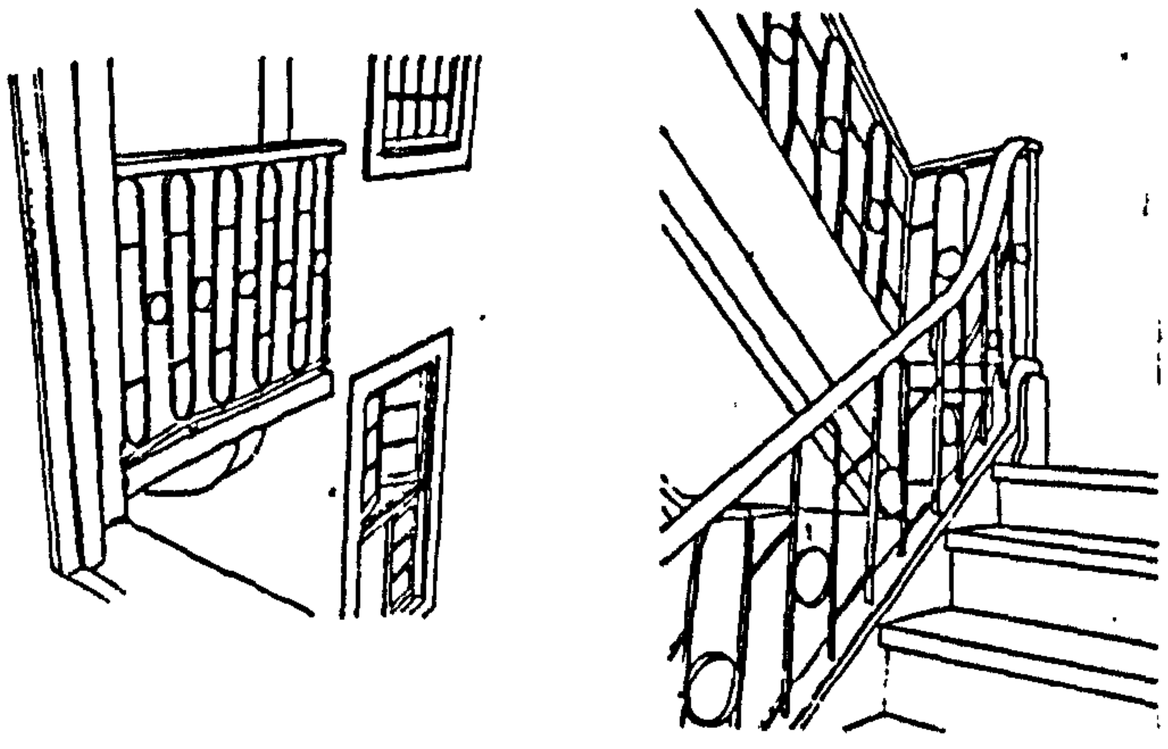


Fig.248-A metal railing used in two different situations, balcony and stairs.

vii)Only a few types of components were selected and produced and the richness and versatility of the compositions which were achieved, derive from the mix of the different components. For example, the patterns of tiling made with three or four different tiles, show a great versatility that can be used in several different situations, such as window recesses dados and staircase balustrades, (Fig.249 and 250).

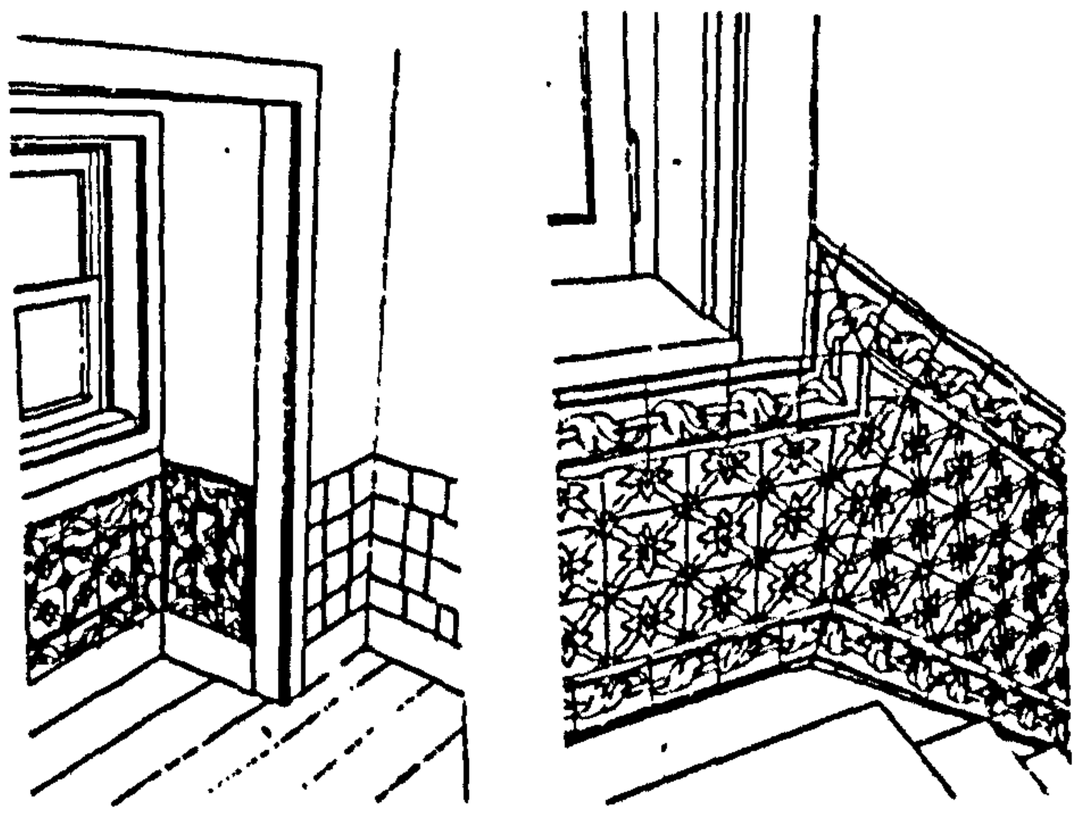


Fig.249-Examples of dados at window recesses

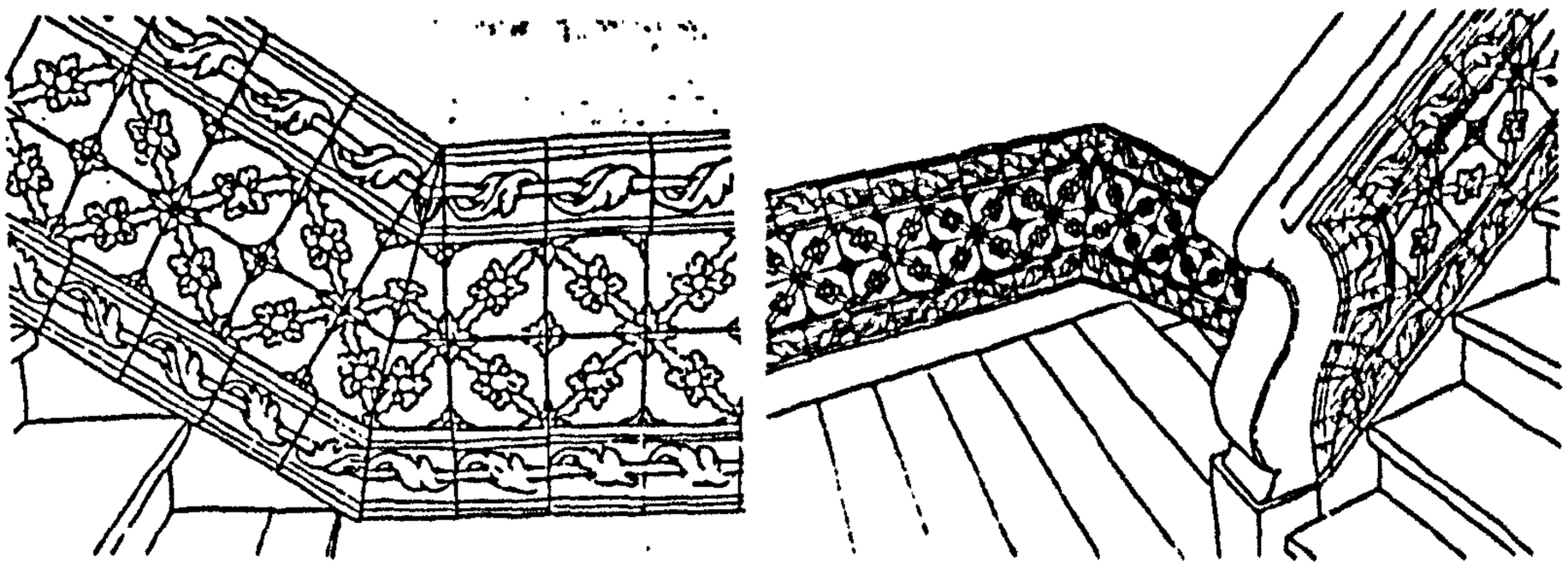


Fig.250-Examples of dados at balustrades

viii)The components were easily interchangeable which allowed for a variety of different combinations and resulted in the creation of numerous styles, (Fig.251 and 252).

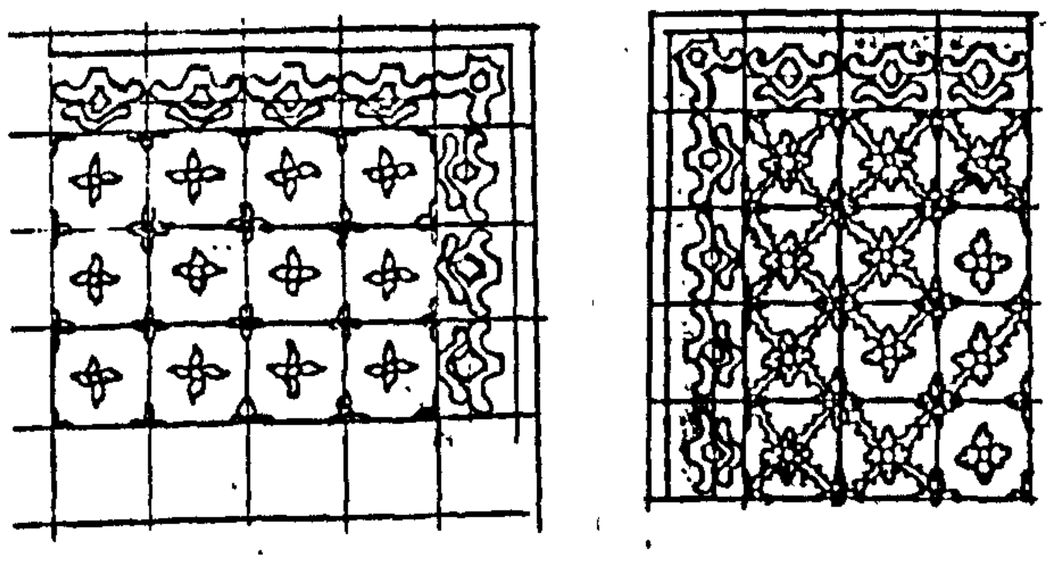
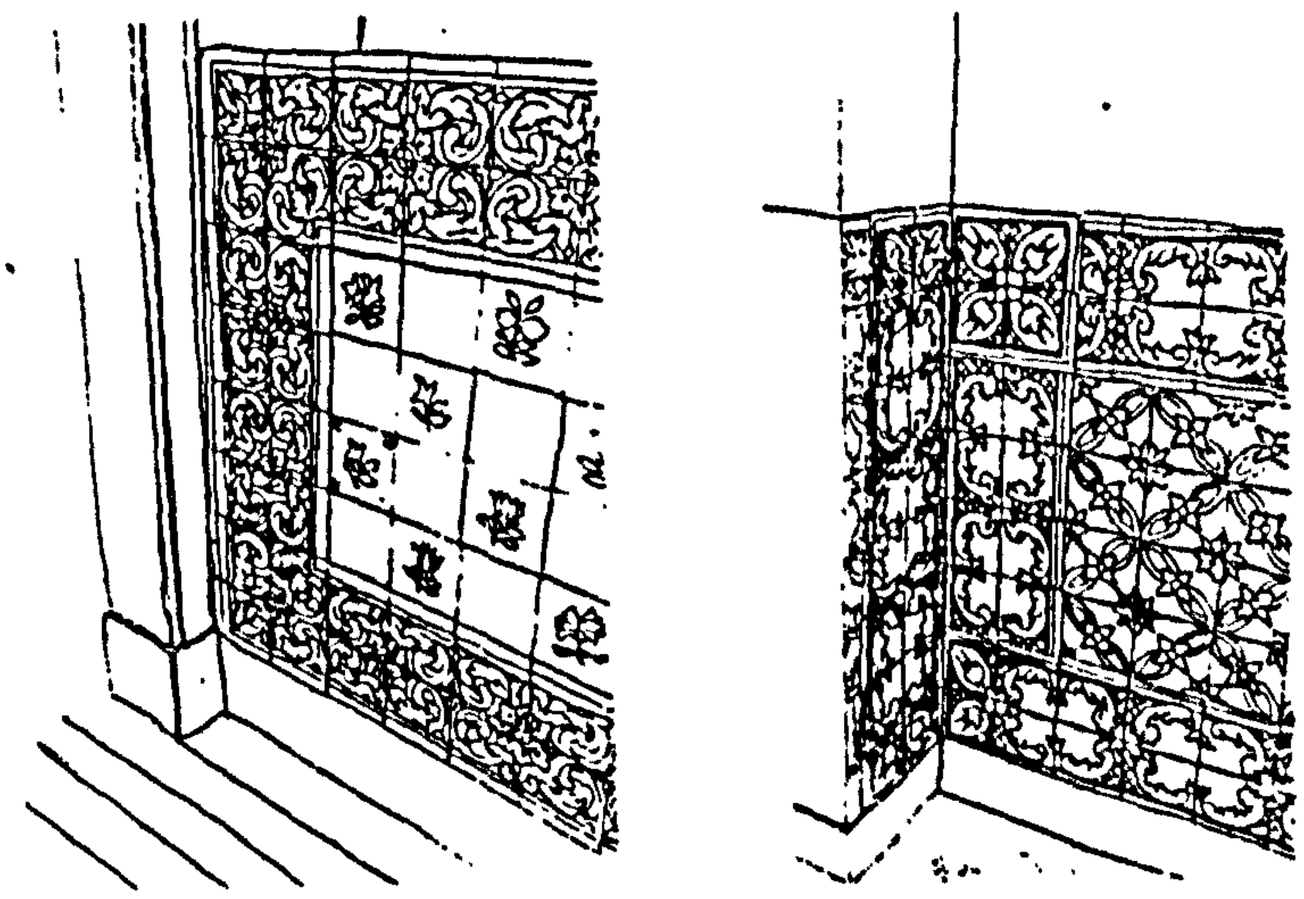


Fig.251-Example of interchangeable border, the same border for different compositions.

In Chapter III (see Figures 160 to 162) it was noted that the wall tiles continued without a break, behind the cupboards, which means that the walls were tiled first and the cupboards assembled independently at a later stage.

Fig.252-The versatility of the borders



The evidence suggests [40] that the components were produced, (Fig.253) in an anonymous and abstract way by craftsmen, remote from the workers who would assemble and fit them quickly and simply, on the sites in the new city.
It is suggested that this was achieved by making use of the numerous materials workshops scattered around the outskirts of the city as well as by organising the workforce already within the city which was not necessarily specialised in an appropriate way. This would then divorce the craftsman producing the components from the building work.

Fig.253-Recreation of workshop, iron work.

From the detailed observations of the components of the Pombaline buildings made by the author (see Appendix 3), it is suggested that the following measures must have been taken in order to make the pre-fabrication of components viable:

i)Simple, traditional models and traditional ways of building were chosen, where the components had been clearly, formally and functionally well defined, (Fig.254).

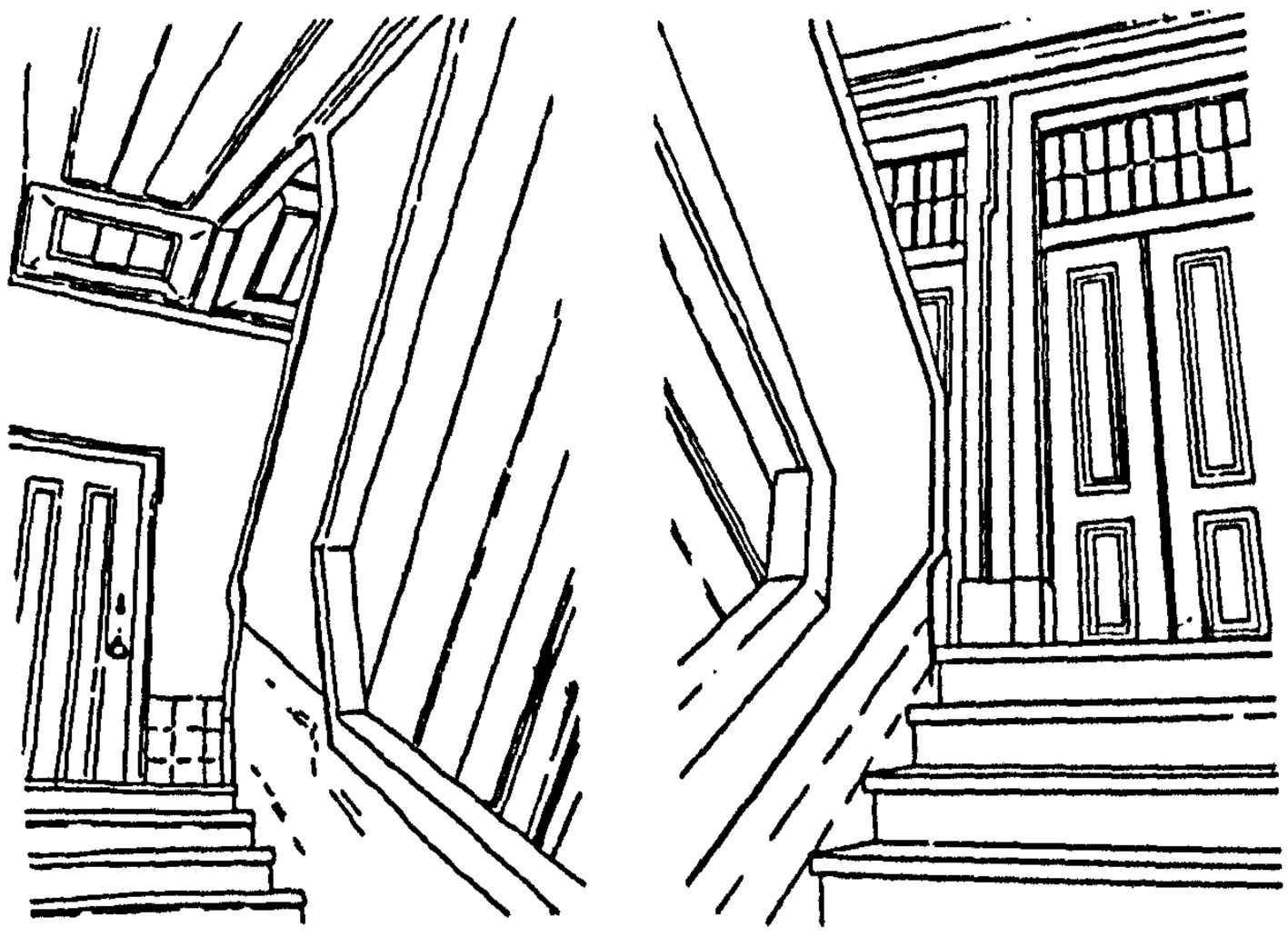


Fig.254-Clear architectonic and constructive solutions

ii)Architectural and constructional details were simplified, without any special embellishments, in order to make it easier for the components to be assembled on site. For example, the components of the *gaiola* compared with sixteenth century British practice, used relatively unsophisticated, jointing techniques which were largely limited to notching, lapping and halving, although in some cases halved dovetail joints are found (Fig.255 and 256). The use of iron and bolts is frequent, and neither carpenter's marks nor mortice-and-tenon joints are generally in evidence.

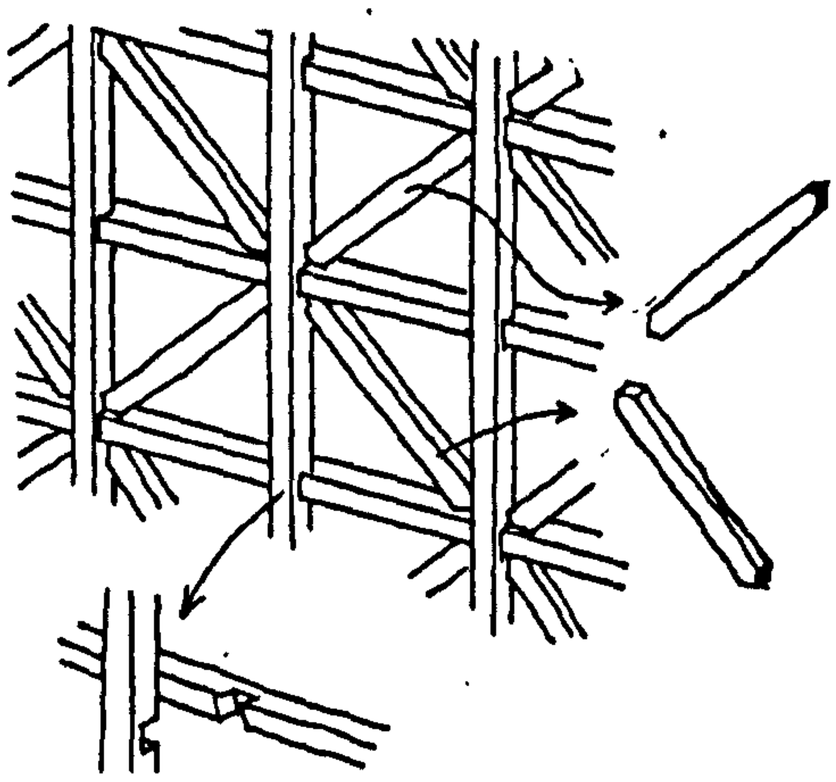


Fig.255-Details of the *gaiola*

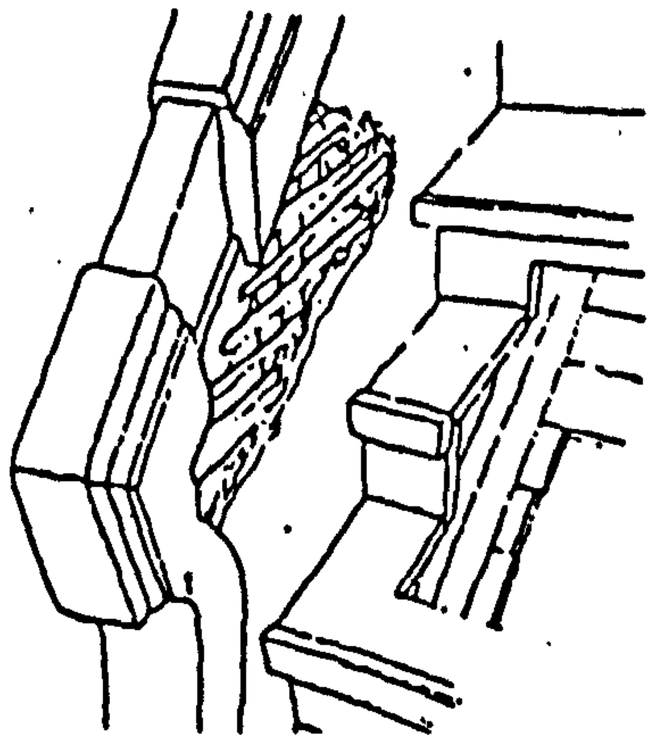


Fig.256-Detail of the stair

iii)The simple nature and uniformity of the components and methods of assembly meant that specialized workmen were not required to fit and erect them. The components were easily adapted to allow for simple interruptions, (Fig. 257).

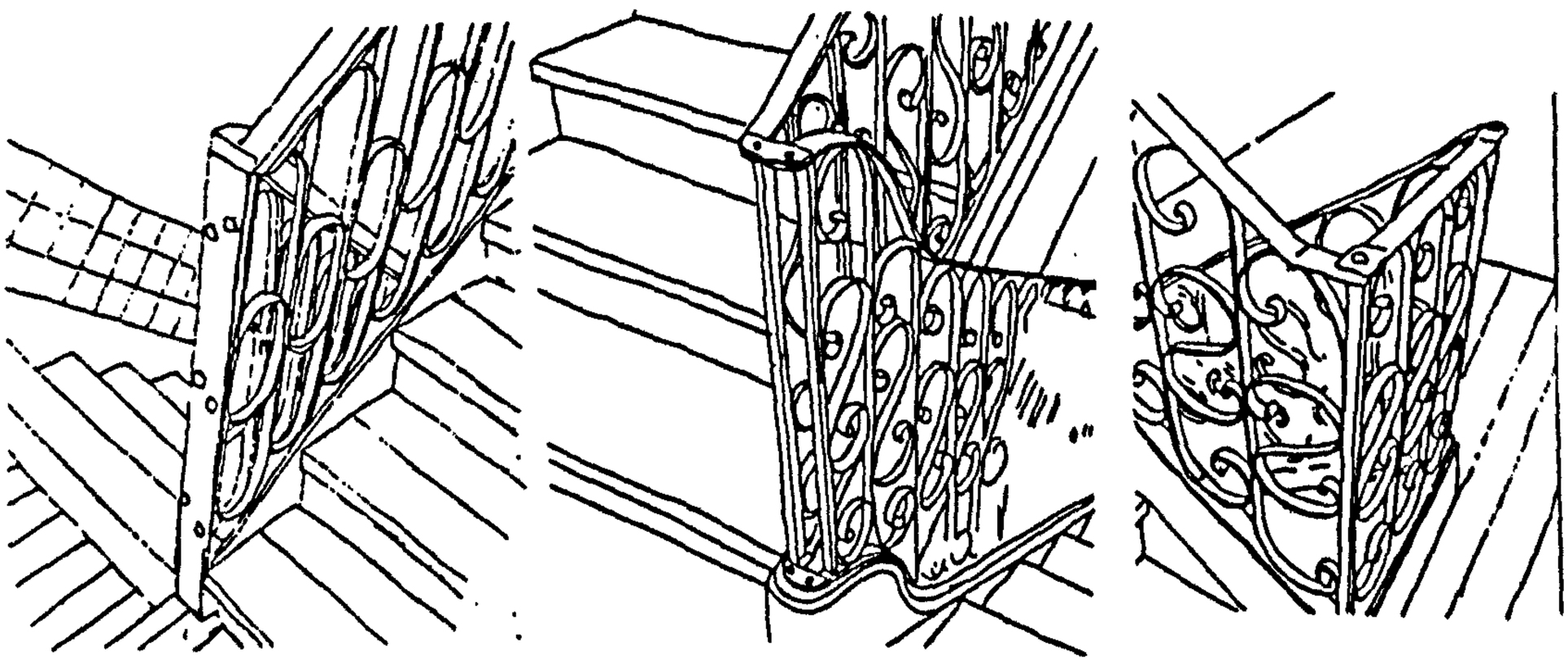


Fig.257-Examples, interruption of balustrades

iv)Abstract compositions were chosen, in order to adapt to different situations, whilst still maintaining repeatability, (Fig.258).

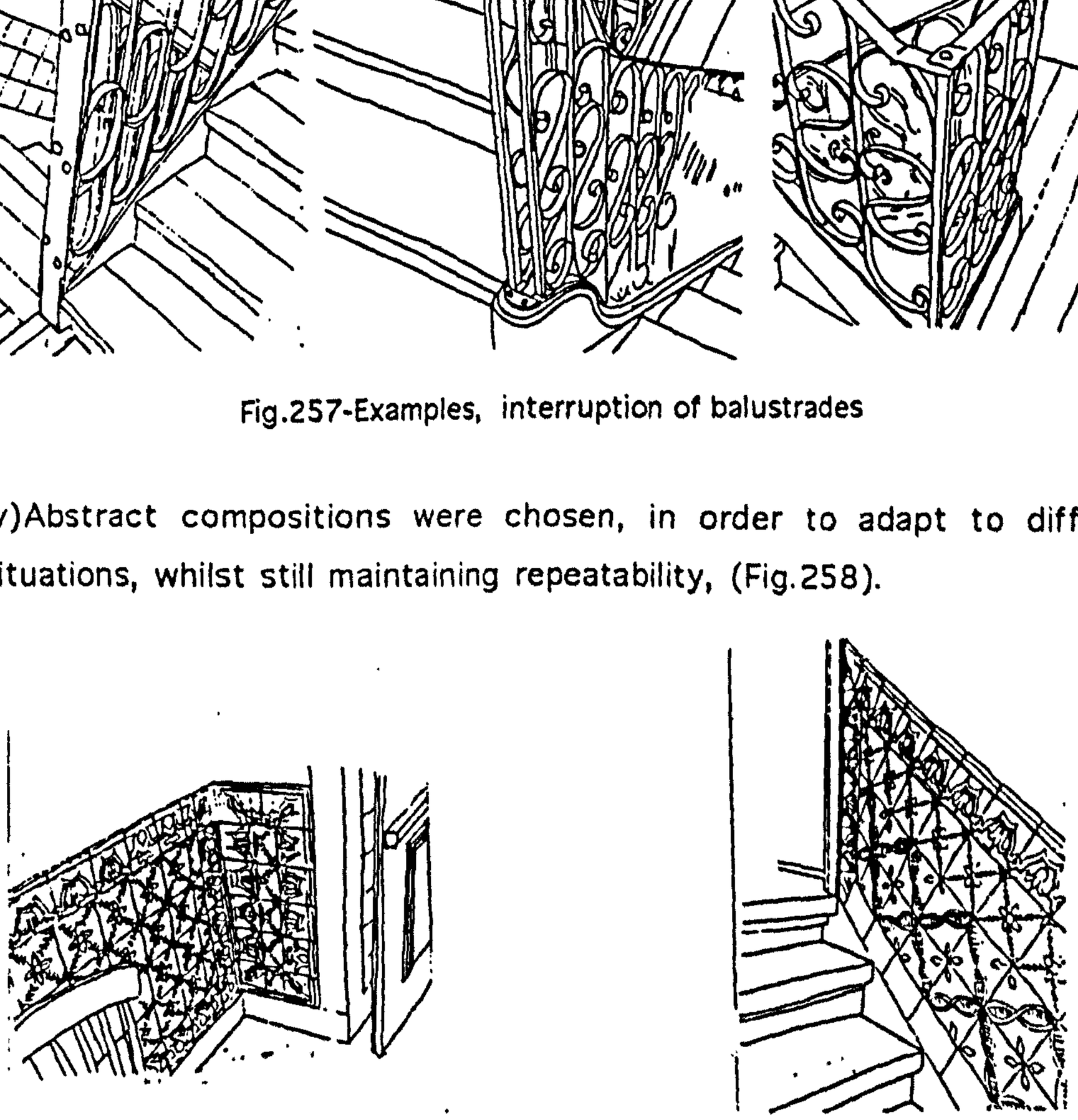


Fig.258-Abstract composition of tiles

v)In fitting and erection it is clear that solutions were found which allowed for small dimensional adjustment to be made. For example the iron balustrade modules could be easily cut to adapt to different size requirements, (Fig.259 and 260).

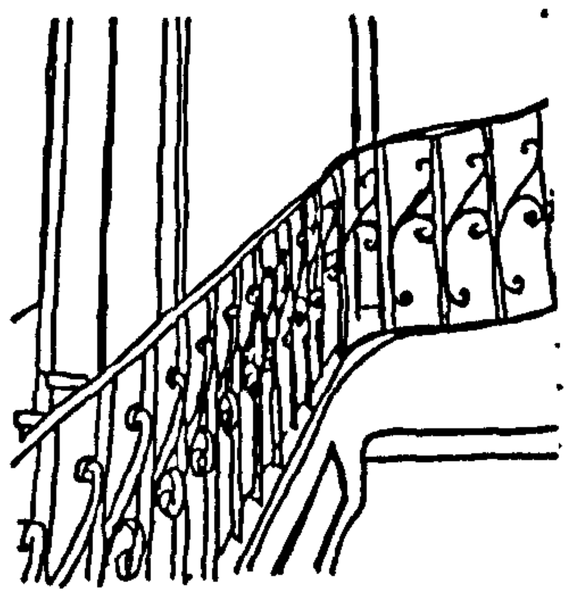


Fig.259-Iron balustrades

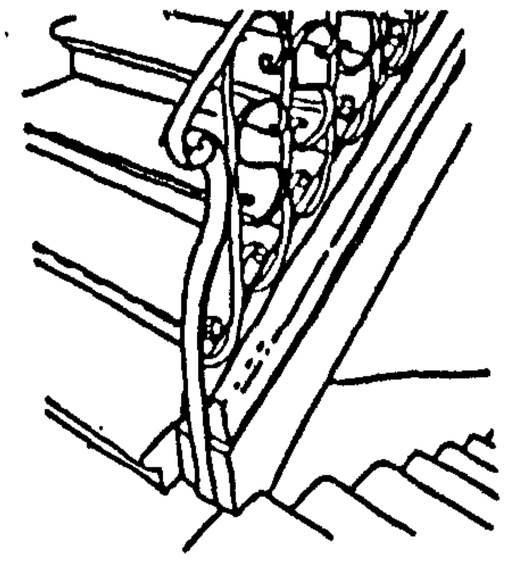


Fig.260-Austere decoration of a balustrade

vi)Components of great solidity without any special finish or decoration were coinceived, which also hid imperfections in the manufacture or assembly, (Fig.261).

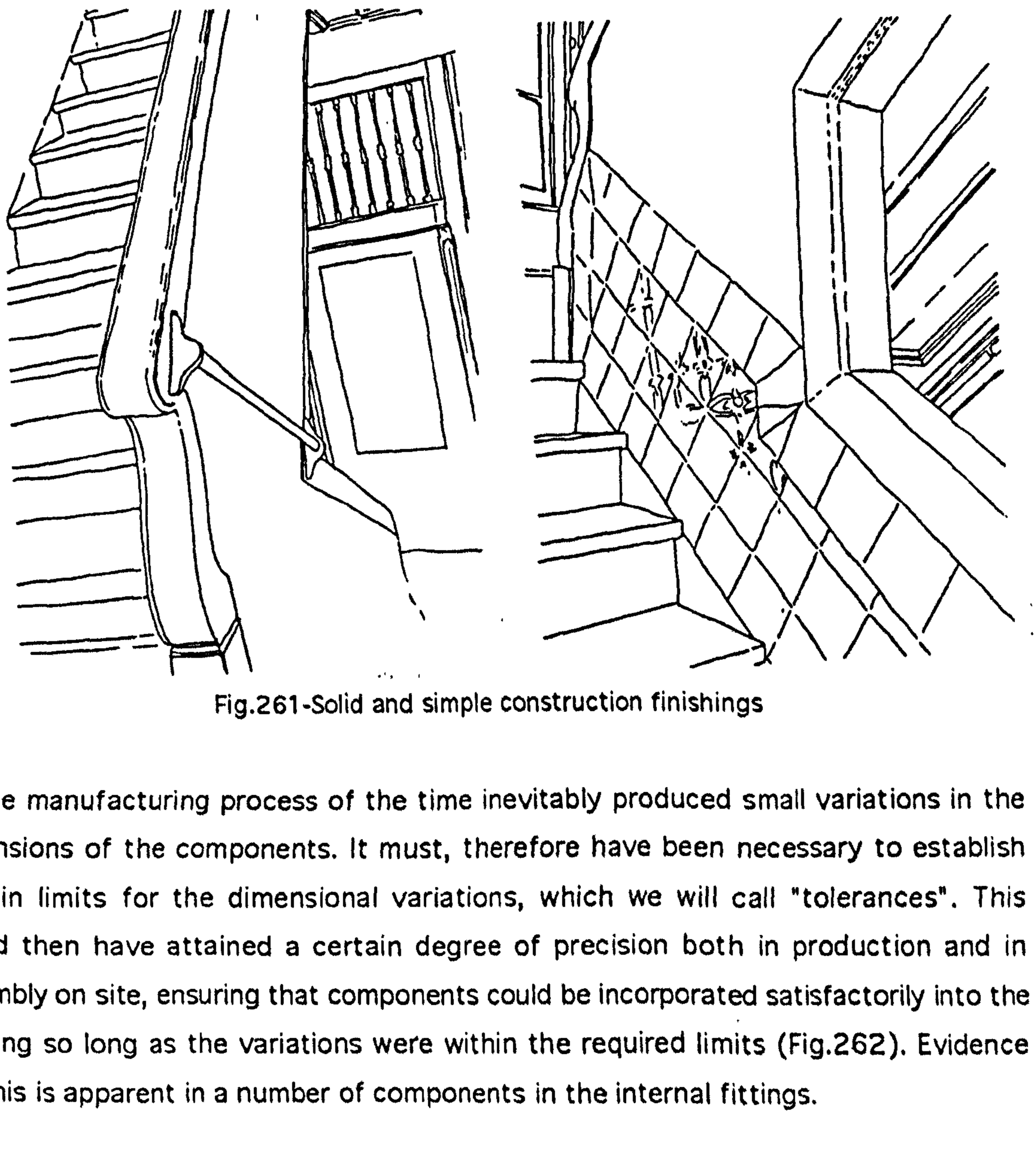


Fig.261-Solid and simple construction finishings

The manufacturing process of the time inevitably produced small variations in the dimensions of the components. It must, therefore have been necessary to establish certain limits for the dimensional variations, which we will call "tolerances". This would then have attained a certain degree of precision both in production and in assembly on site, ensuring that components could be incorporated satisfactorily into the building so long as the variations were within the required limits (Fig.262). Evidence for this is apparent in a number of components in the internal fittings.

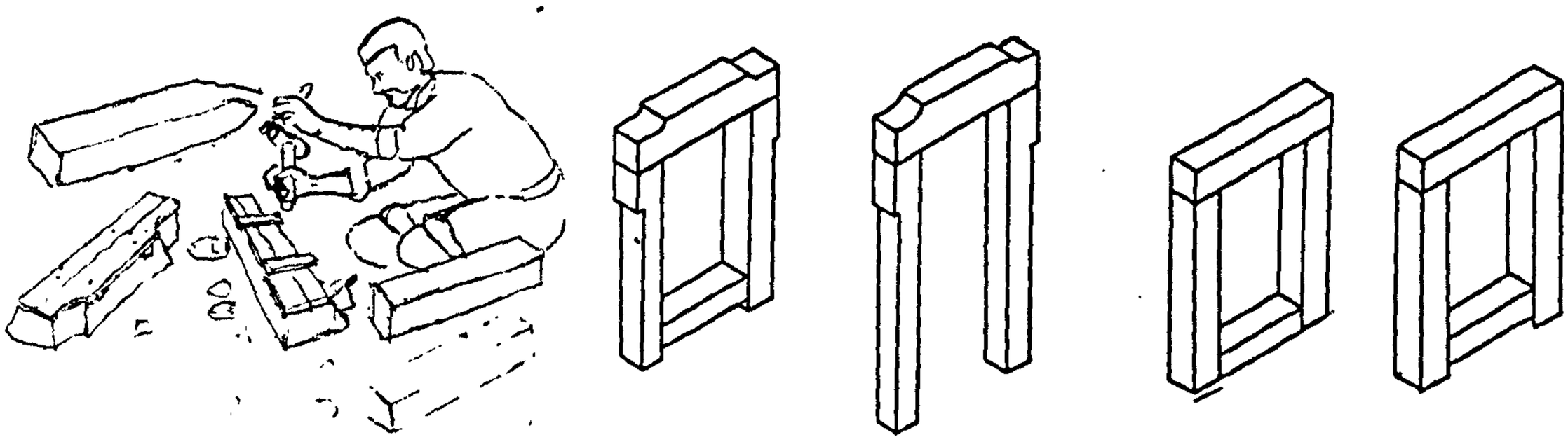


Fig.262-Production and assembly of a component.

To study the assembly on site, of a pre-fabricated building element, an example has been chosen with a relatively high potential for complexity both in its assembly on site and its prior conception. The example chosen is one of three doors at the entrance to a flat in the building number 75, *Conceição* Street. (Fig.263 and 264) The set of doors was inserted into the modular space on the plan, which, in the design, would measure approximately six palms (6x22.5cm). In the case of 75, Conceição Street the actual measured width of the opening was 130 cm (Fig.265).

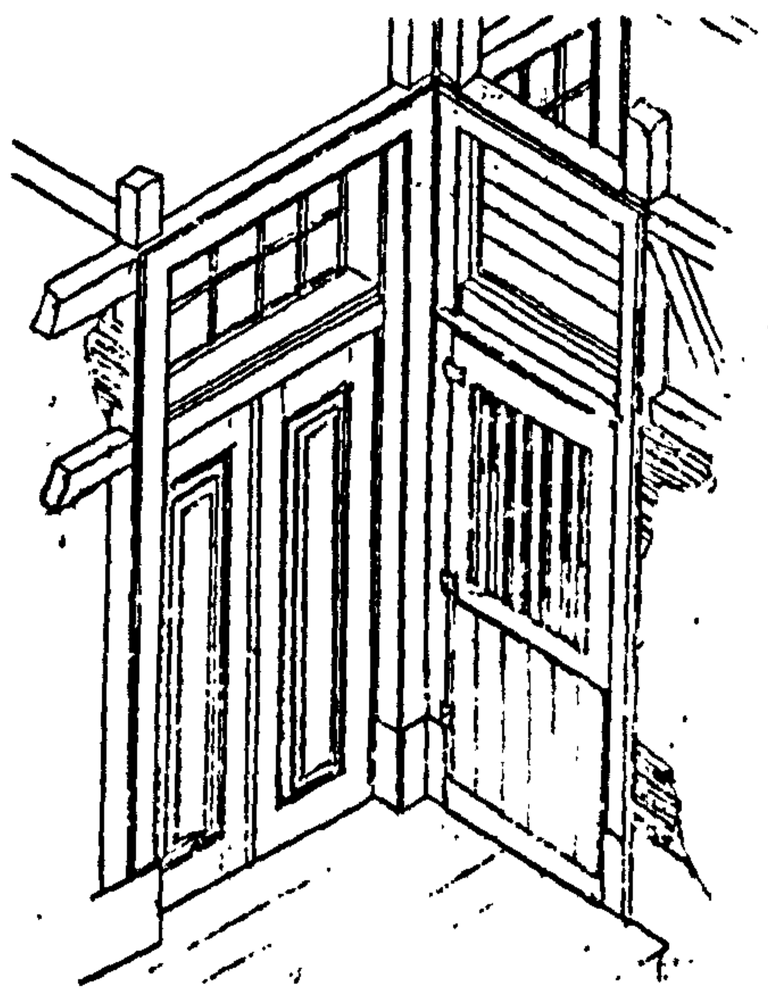


Fig.263-Isometric of three doors, (inside)

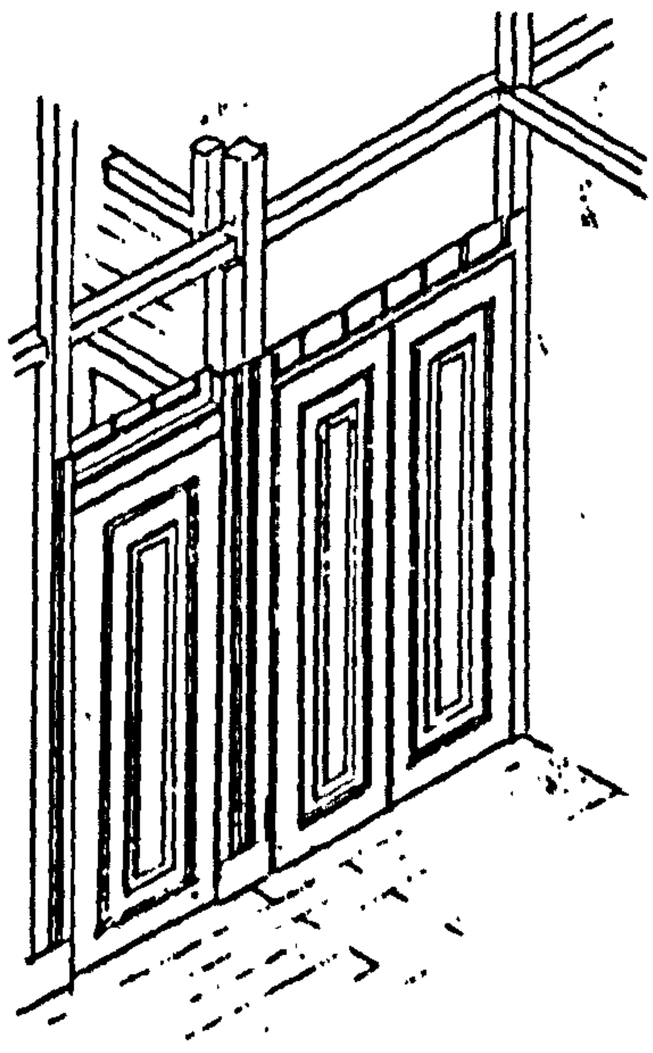


Fig.264-Isometric of three doors, (outside)

If an attempt had been made to manufacture components totalling exactly six palms wide, any error within a small tolerance would make it impossible to fit the component into the space.

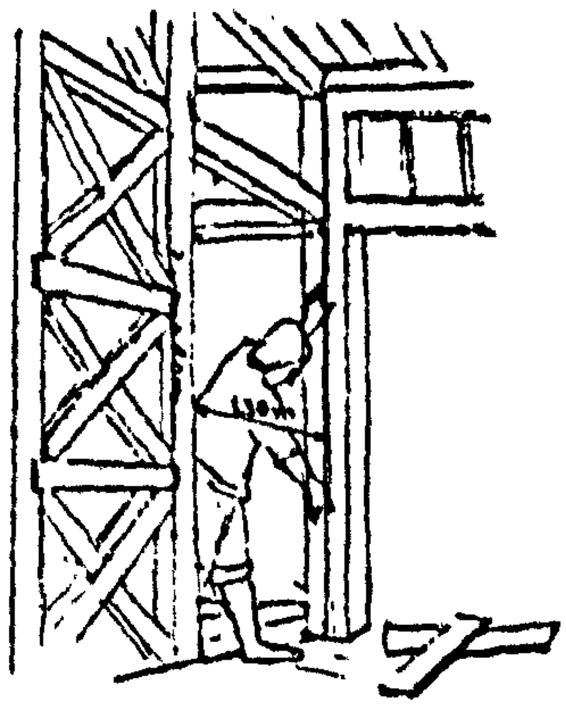


Fig.265-Assembling a door

To overcome this problem, "tolerances" were introduced. A "tolerance" is seen as the difference between the maximum and minimum component dimension allowed (permitted upper limit and permitted lower limit respectively).

The detailing of the doorway is such that it allows for adjustment of the partition, the width of the door leaves, and the height of the door leaves, (Fig.266 and 267).

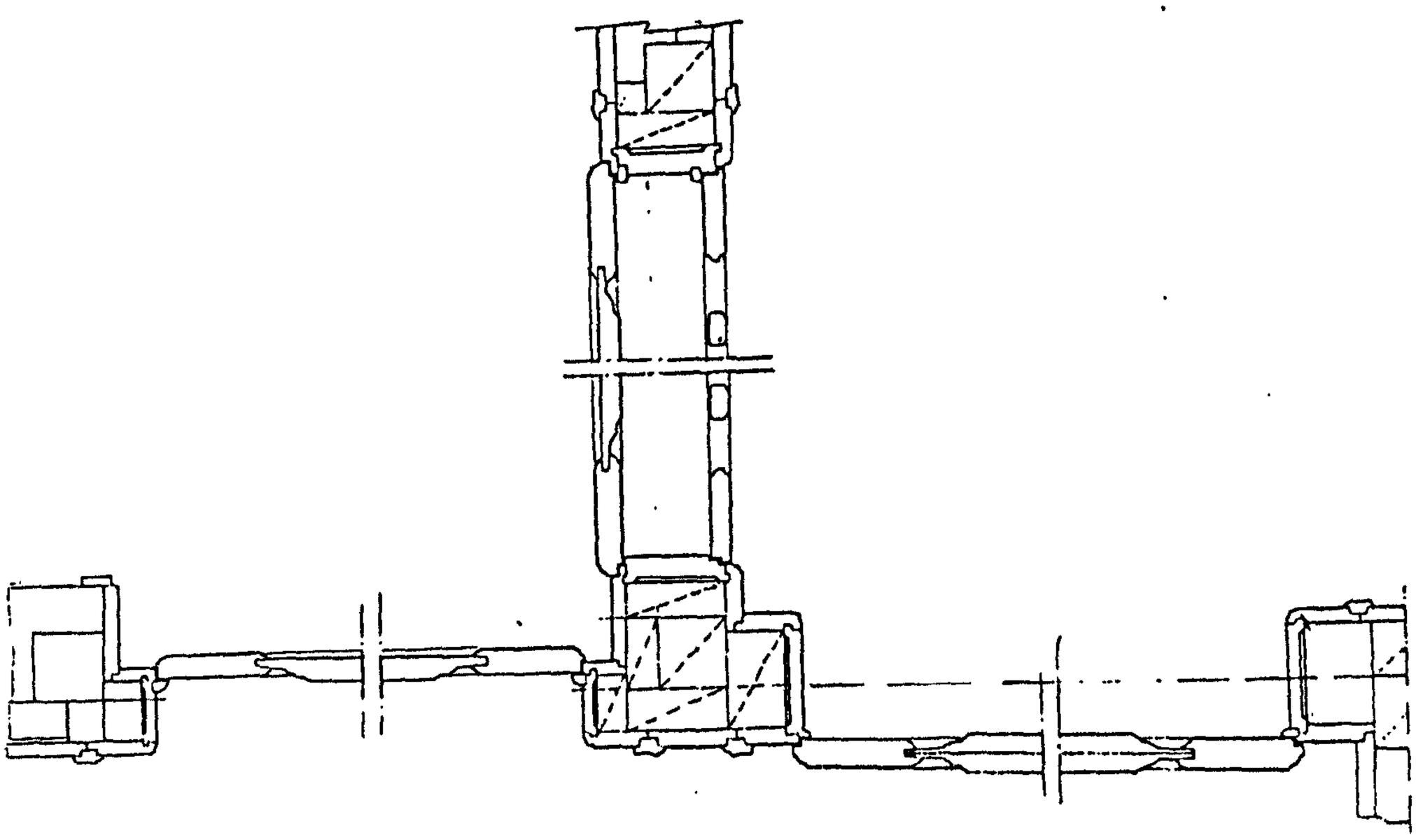


Fig.266-Horizontal section through three doors

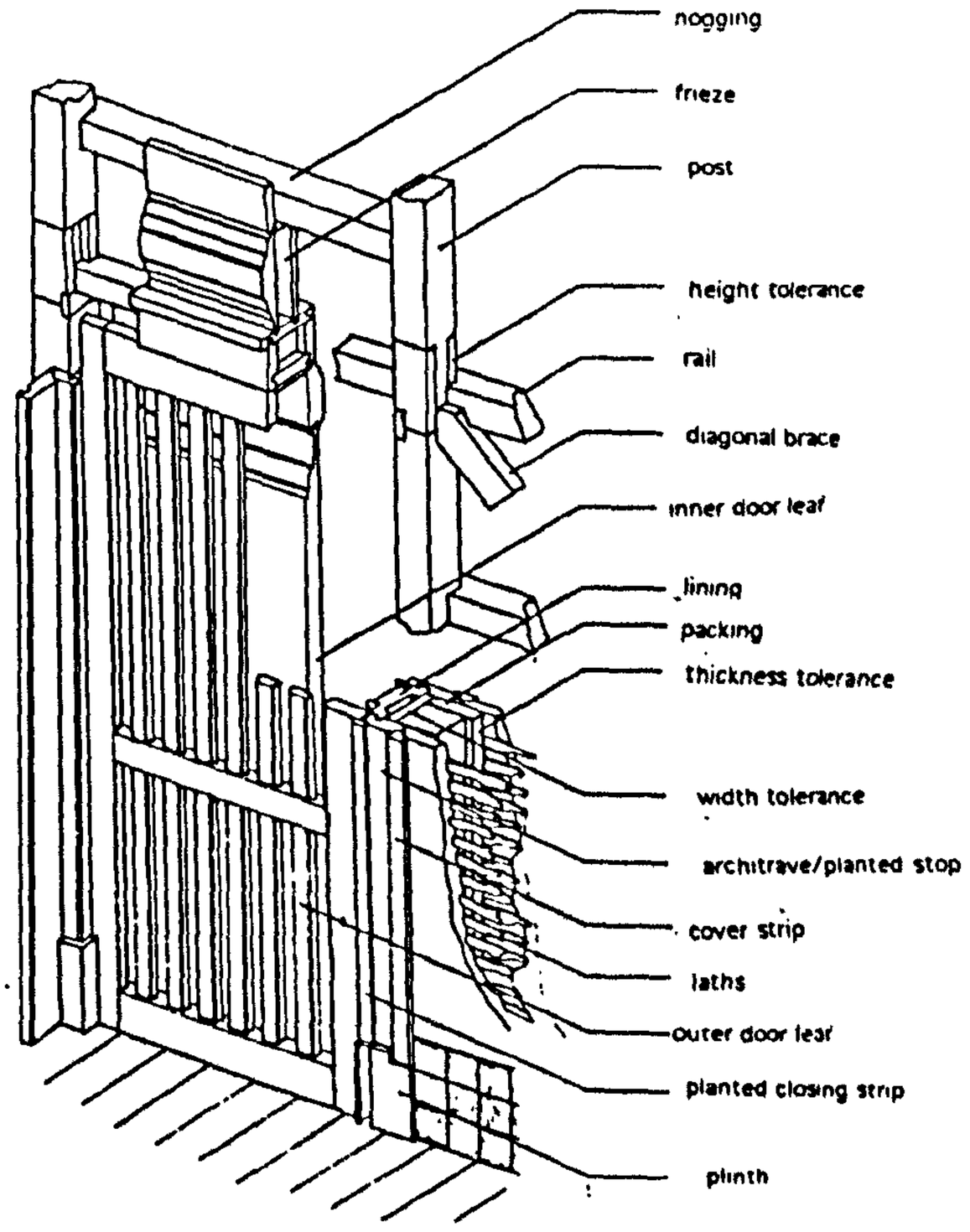


Fig.267-The door studied and its associated components.

The thickness of the partition, and therefore also the width of the door lining is adjusted by varying the thickness of packing pieces. These are planted on the face of the post in the gaiola next to the doorway, to bring it flush with the face of the nogging over the doorway which is lapped over the post on either side (Fig.269). The thickness of these packing pieces could be varied by as much as 10mm above and below the norm.

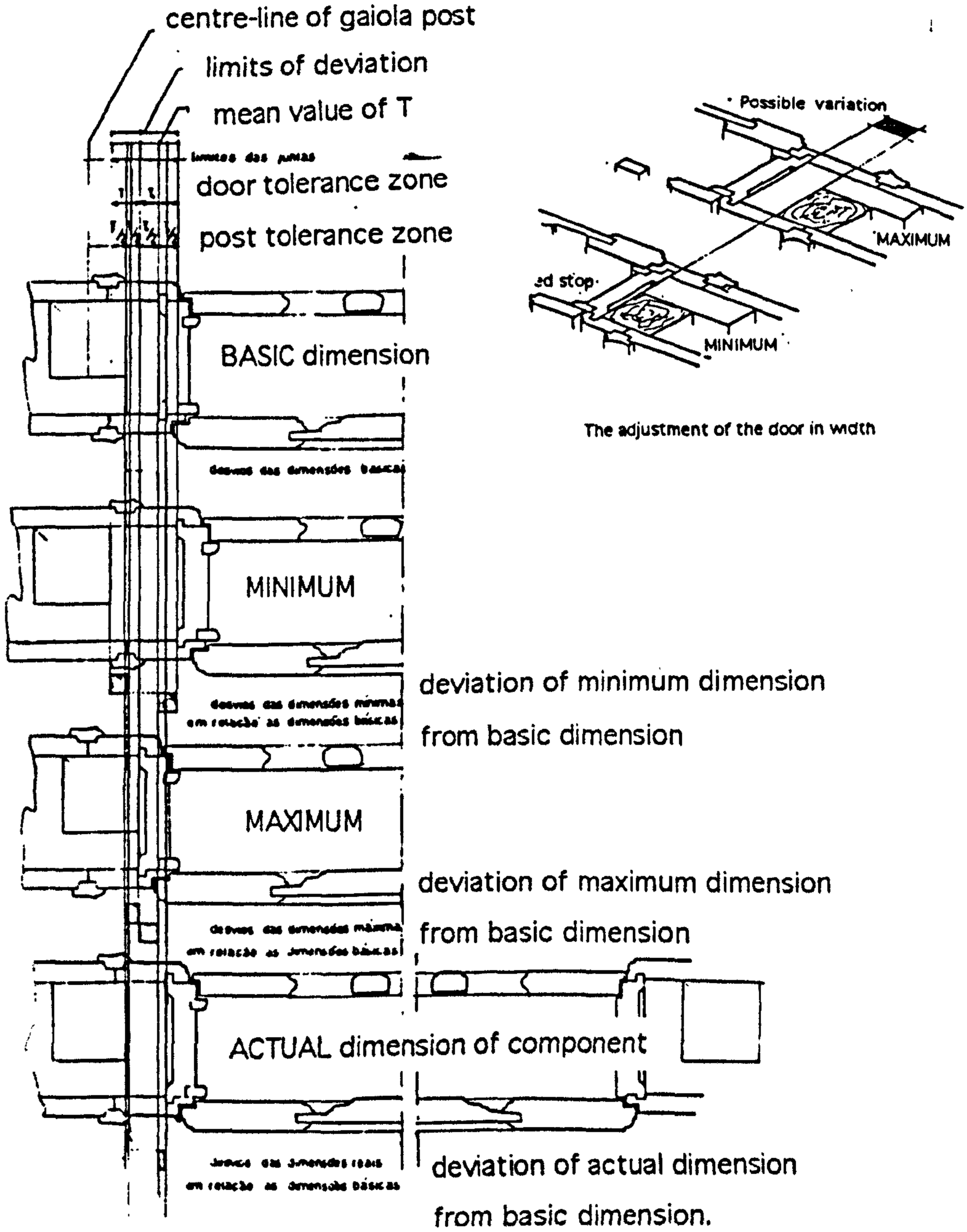
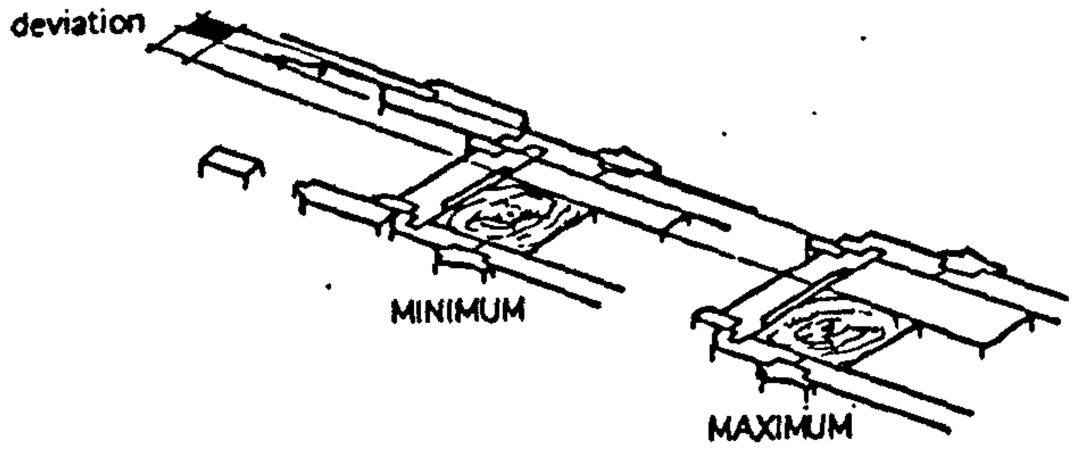
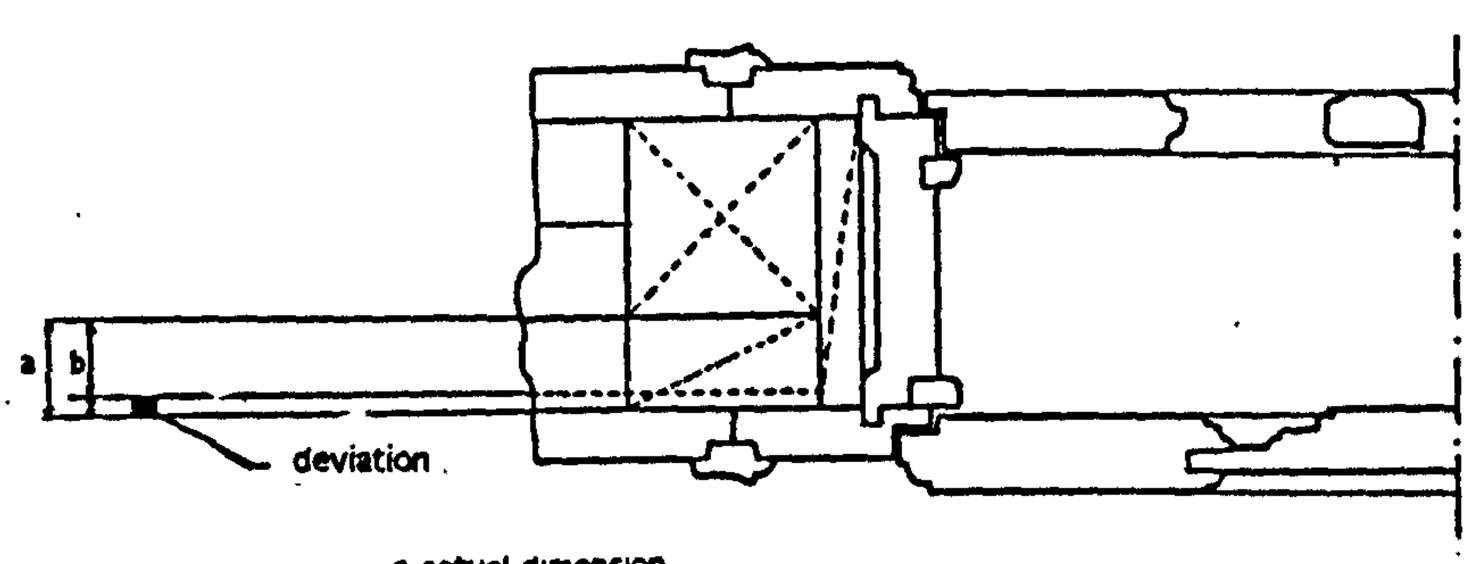


Fig.268-Tolerance of the width of the door leaves

The adjustment of the door in width

The width of the door leaves, or strictly speaking the space occupied by the door leaves, is adjusted by packing pieces planted on the doorway face of the *gaiola* post, which pack out the door lining. These packing pieces can vary in thickness from nil to 100mm (Fig.268).



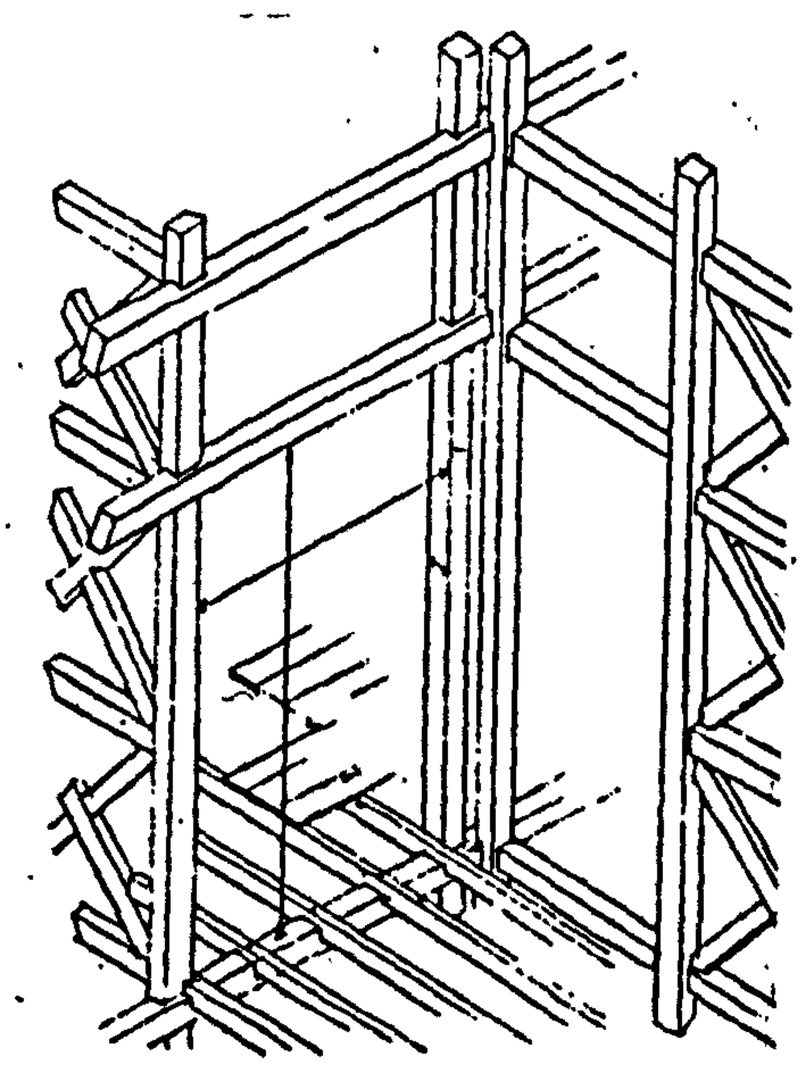


a-actual dimension
b-basic dimension of the projection of the rails/noggings.
(inside the face of the post of the *gaiola*).

Fig.269-Tolerance of the thickness of the partition

Both this variation and the variation in thickness of the packing pieces described above can be used to accommodate inaccuracies in the construction of the *gaiola* as well as variation in the widths of door linings and door leaves. However the mechanism for adjusting the height of the door leaves involves altering a dimension of the *gaiola* itself and its presence can only be explained by substantial variations in the heights of mass-produced door leaves obtained as standard components from stock, or "off the shelf"(Fig.270).

Fig.270-Dimensions of the structural opening for the doorway



The dimension of the gaiola which is altered is the height of the nogging which forms the head of the structural opening for the doors. The alteration is effected by varying the size of wooden inserts which fit into recesses in the gaiola posts on either side of the doorway, (Fig.271). The height of the door leaves can be varied up to 20mm above and below the norm (Fig.272).

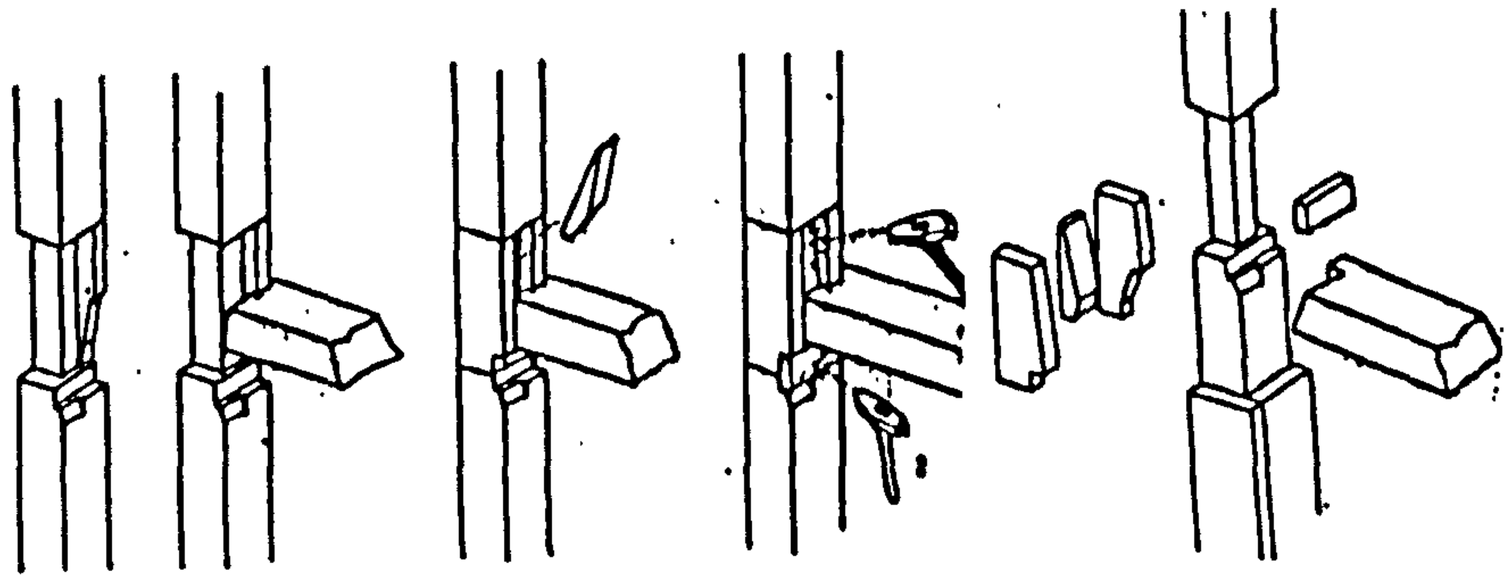


Fig.271-The adjustment of the nogging of the cage to the door

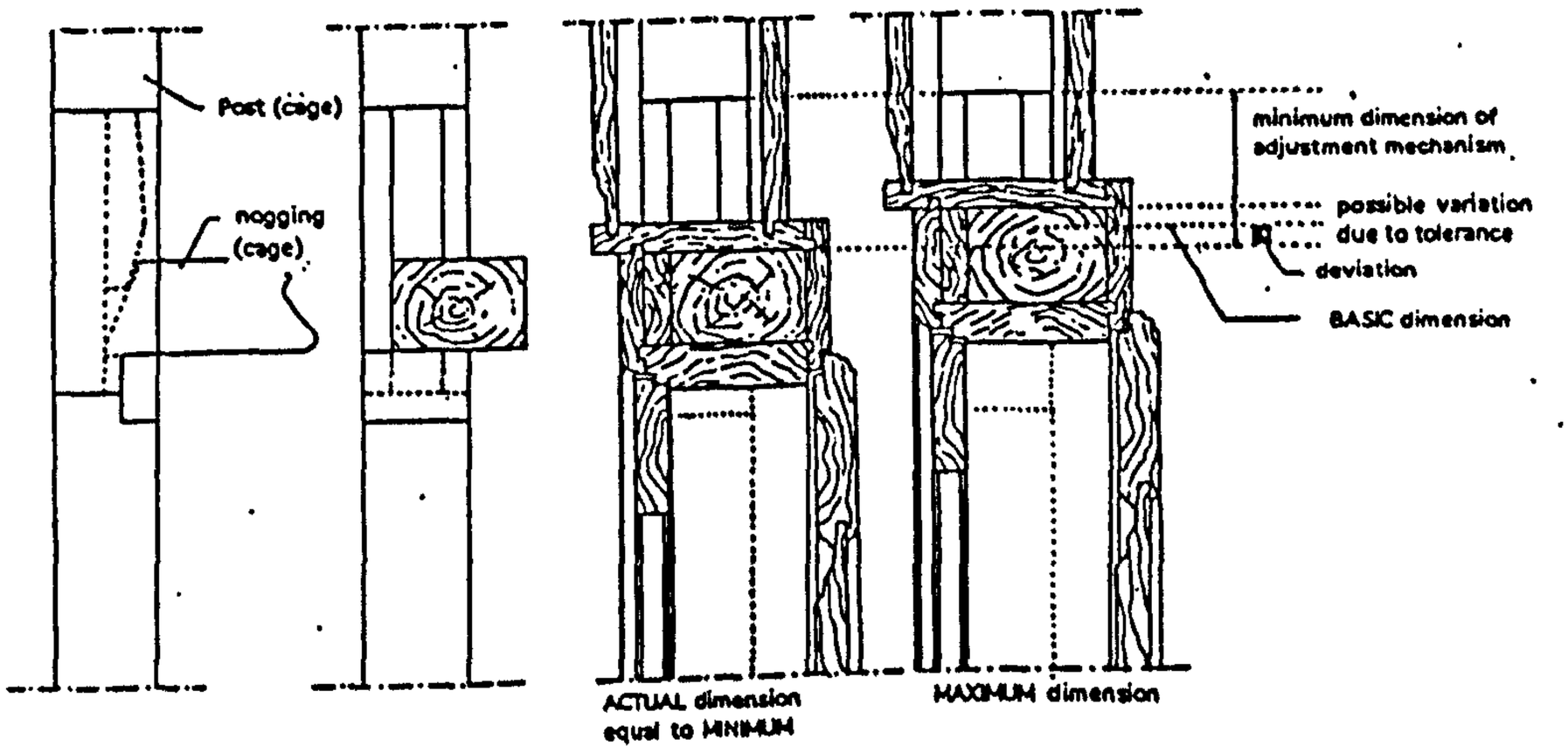
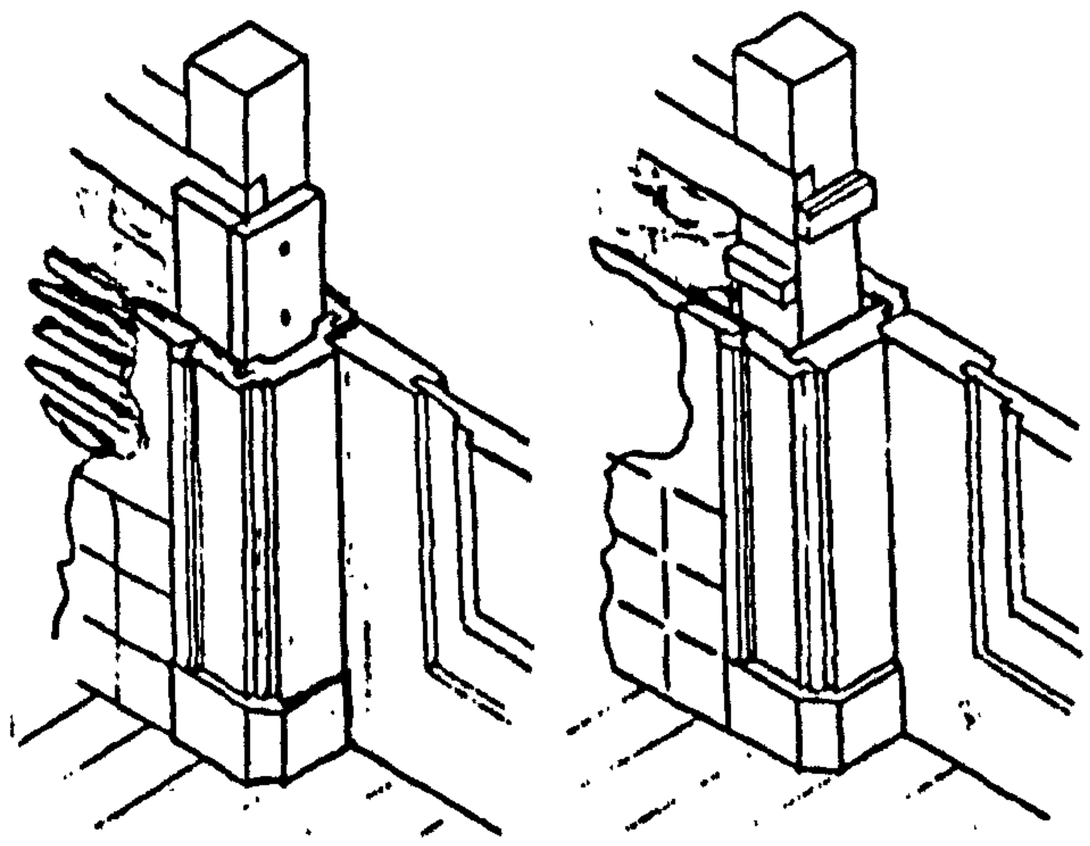


Fig.272-The adjustment of the door in height

Precision costs money because of the discipline that is imposed, which along with the craft-based manufacturing process meant that it was not always possible to reduce the size of the "tolerance". Consequently, in the Pombaline rentable building, in an attempt to build in a simple, and quick method of adjustment, the "tolerances" became very large and also became more simple using short pieces of wood, (Fig.273).

Fig.273-A "tolerance" carefully done and an other simpler version



These are greater than the variation which we would expect in mass-produced standardised door leaves today, but this is probably due to inconsistencies in measuring instruments used in eighteenth century Portugal, together with the large number of small workshops from which the door leaves would have been obtained.

To make assembly easier the gaps were covered by planed architraves, with simple joints, which were easily adjustable to the size required on site, covering any further imperfections with other decorative finishes. The tolerances are not only seen at the building level but also at the urban plan level.

Because the measuring instruments used at the time were very rudimentary, the setting out of the plan on the ground resulted in small errors in measurement which were promptly covered up through the subtle use of tolerances in the building`s facades.

The pilasters in the centres of some blocks covered up the difference between the aesthetic harmony of the design and the size actually built, (Fig.274 and 275). This is also due to the fact the elevations had to have exact dimensions because the components of façades such as windows do not have any "tolerances".

Fig.274-The pilaster

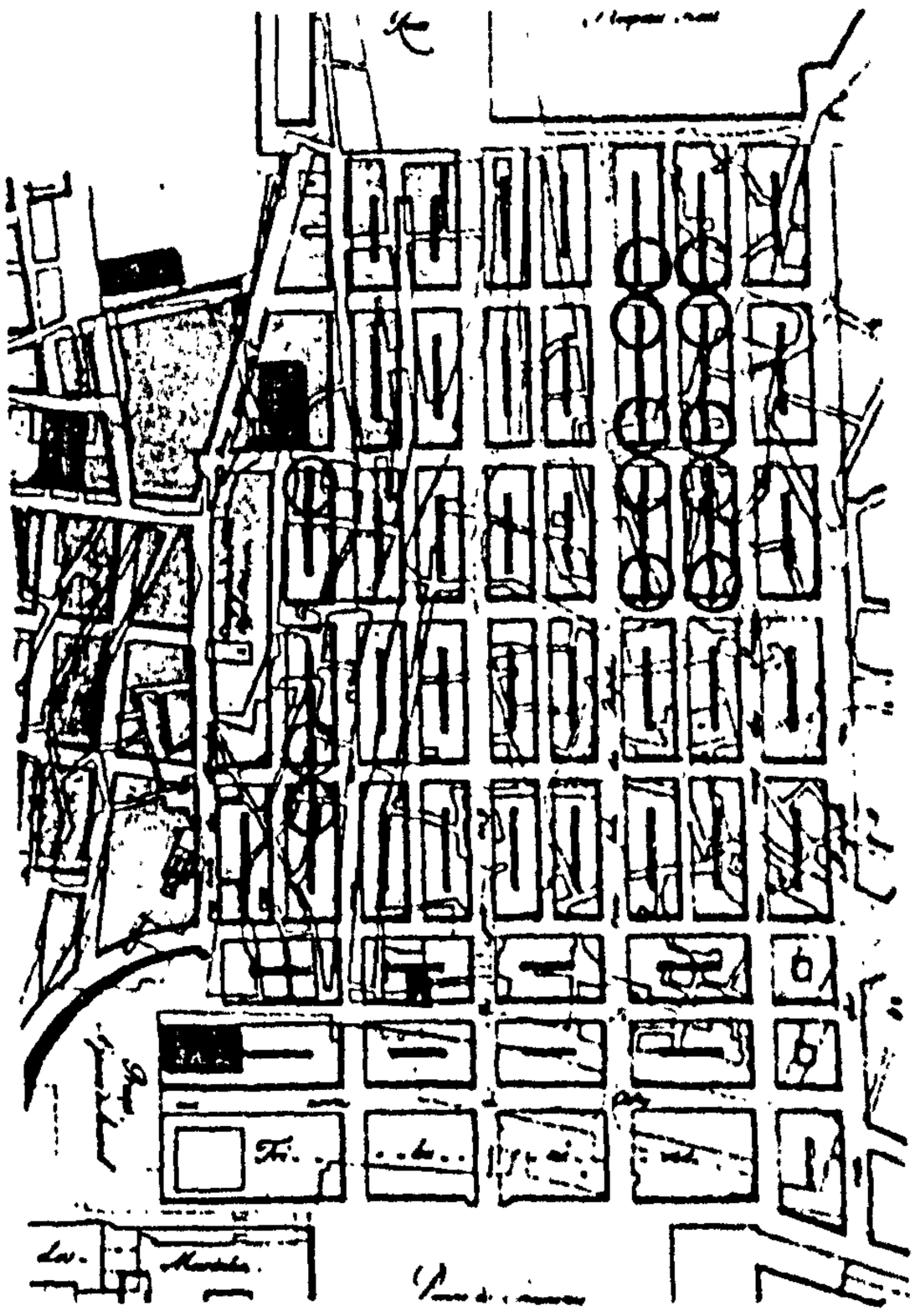


Fig.275-Locations of the pilasters Ⓣ

IV.3. Summary

In this chapter the innovations introduced in the Pombaline buildings, with respect to health and safety measures, have been identified and described. Many of these innovations were clearly in response to the devastating experience of the effects of the earthquake on the original buildings and their inhabitants. This resulted in an ingenious building design. Below ground level the buildings were supported on a network of vaults resting on wooden stakes. Short stone columns interconnected by stone arches rested on the timber platforms and supported the buildings above ground level. The ground floor space was covered by stone vaulted ceilings and above this the structure consisted of a wooden cage or *gaiola*. Many of the design features of this structure and the internal details associated with it were clearly produced to resist any future earth tremors.

In the plans of the area of reconstruction, the distribution of the buildings within that area, the building façades and dimensions and the internal plans, there is clear evidence of dimensional co-ordination. Running through all these is evidence of geometrical relationships which must have derived from the application of a number of geometrical principles. This is particularly apparent in the modulation of the façades which show a twelve palm repeat and also an underlying square grid pattern (of repeat length 12 palms) which it would appear was used to generate the room plans.

Almost certainly developing from this strong element of dimensional coordination is the use of prefabricated building components, of which there is abundant evidence in the buildings which have been surveyed. Prefabrication has been suggested previously by a number of authors but not substantiated. The previous chapter has shown that there is not only evidence of use of prefabrication in old documents of the period but also in doors, windows, balustrades, doors surrounds and even the cage structure itself at the existing buildings. Also many cases, designs and systems were clearly developed to allow for variability in component dimensions and unsightly joints or joins.

The documentary and physical evidence discussed above, all suggest that the standardisation of huge numbers of windows, doors and their associated dressed stone lintels, jambs and sills enabled their prefabrication, mass-production and supply from stock when required. Ceramic wall tiles and wrought iron staircase balustrade components were also produced and supplied in this way. This standardisation of components and the associated standardisation of the design of the buildings, into which they were incorporated on such a large scale is, to say the least, unusual for the eighteenth century, and surely deserves international recognition.

From the knowledge of the detailed characteristics of the Pombaline rentable buildings derived from the survey the next chapter will analyse a possible evolution of

particular aspects of the buildings. During the survey (the results of which are reported) it became apparent that different types of plans had in common certain types of stairs (see Chapter II.2.), the location of which in the plans seemed to be related to an evolution.

At the beginning of the next chapter, it will be seen that the process of reconstruction dragged on for a long time. From the analysis of the exteriors and the interiors of the buildings in Chapter III it was concluded that the elevations had been strictly imposed and had been followed during the whole period of reconstruction, whereas the interiors had been defined by the owners' own tastes. This should make it possible to identify any evolutionary developments which may have occurred over the construction period. Based on the variations in the internal plan a classification system is developed based mainly on the position of the stairs, and particular phases are identified. The internal details associated with these different phases are recorded and historical records are consulted to obtain data on the number of buildings erected in different streets at different stages of the total construction programme (see Appendix 4). The classification system of the different phases is then compared with the historical data.

CHAPTER V. FACTORS WHICH INFLUENCED THE INTERNAL PLAN OF THE POMBALINE RENTABLE BUILDING.

V.1. The progress of the building programme.

The reconstruction of the business centre of the city was not immediate. It continued for many years and extended beyond the five year time limit for completion set down in the "12th May 1758 licence"(2). Although the procedure for the redistribution of properties had been established in advance, this took time. The levelling and clearing of rubble from the land was, in many cases, dependent on the owners making use of the materials from the ruins, which in turn, delayed the building of the infrastructure. Progress was also no doubt impeded by the profusion of wooden shacks which were erected despite public notices prohibiting them.(31) The account of a foreign traveller who visited the city nine years after the earthquake throws some light on this matter: "The damage caused by the earthquake still appears to have been recent; the majority of the streets still show signs of demolition and ruin".(57)

The progress of the reconstruction of rentable properties was "irregular"(20); Pombal had planned financial arrangements to compensate land owners for their efforts to reconstruct, but these did not prove adequate in practice, especially in cases where they had to take out mortgages, so in 1769 and 1771 the unbuilt properties were compulsorily sold (31). In the 13 Kilometres of streets that constituted the Pombaline area there were in 1766 only 59 buildings, 31 of which were in Augusta Street (47 e 58) (the street which linked the two main squares).

Ten years later a total of just 140 buildings had been completed.(20)

With the fall of Pombal in 1777, due to problems at the Treasury, public works were immediately suspended (20). At this stage only 25% of the Pombaline area (20) had been rebuilt. Many more buildings were built around 1790 and then a process of decline set in during the French Invasions (1810/1830) (47).

The Rossio was only finally completed in 1840 (20).

V.2. A study of the possible evolution of particular aspects of the buildings

The reconstruction by Pombal of the Lisbon town centre, constituted an important urban development. As outlined in previous chapters it involved a complex reconstruction process, over a large area with technical innovations and, the standardisation and mass production of components. It also included various hygiene and safety measures, including in the latter case resistance against earthquakes, through the systematic incorporation of a wooden cage structure which allowed buildings to accommodate movement without collapsing when built on unstable terrain. This marked an important period in the panorama of Portuguese architecture.

As outlined in Chapter II the author carefully studied the plan form and exterior details of 304 buildings, which includes in particular the location, construction, design and style of stairways (see Appendix 5). The author noted that there were no two plans alike although there were building lots that were the same in size and where, as previously established, the position of the walls had been defined by simple, regulatory lines (see Chapter IV). Faced by this great diversity the author began to analyse carefully the stairways and established that there were a number of well defined types (see Chapter III). There also exist types very similar to those that could be found in the medieval parts of the city and others which were similar to those found in the parts of city that were built much later. Although many of the technical innovations were imposed right at the start, there must have been others that were defined during the construction work, during the prolonged period of reconstruction. This would particularly be so in the development of the interiors of the buildings (2).

In order to understand any possible evolution of the existing plans it is necessary to determine how the planners initially intended to divide the properties internally. Careful observation of the drawings of the elevations shown in the early plans (catalogue of exibition "Lisboa e o Marquês de Pombal"(21), volume II, illustrations 108 to 111) showed that properties in four of the initial drawings had dividing walls between buildings coincident with the window alignments (see Figure 276). This suggests that division of properties behind the façades would be irregular. This was clearly abandoned as properties are in practice divided in a regular manner.

As has previously been established the plans were not made in a haphazard way but were restricted by the modulation of the spaces in the façades, which determined the dimensions of the individual buildings within each block.

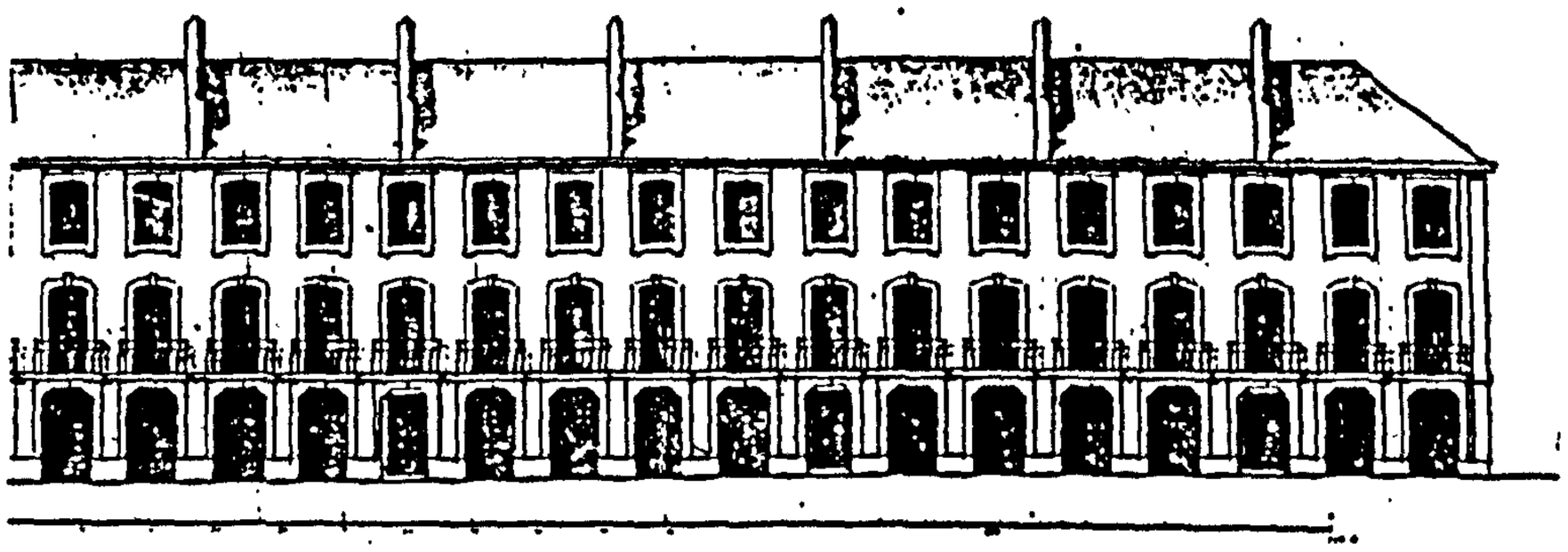


Fig.276- Elevation proposed in the beginning

By carefully analysing the plans it was possible to group them clearly by stair types, keeping in mind the principal requirements of the residents. These are still relevant today such as the need to have the kitchen facing the courtyard, and the sitting room facing the street, with immediate access from the staircase. This development was accompanied by what appeared to be an evolution in the definition of the spaces in the plan. In the Pombaline area there can be found rentable buildings of interior plan similar to medieval plans of houses. These are without corridors and the room divisions are crossed via multiple doors situated in the middle of the interior walls and with a single straight flight of stairs to the first floor, (Fig.277 and 278). There can also be found rentable buildings with plans similar to many still built today, (Fig.279), with corridors and double stairs in the centre.

Fig.277-Medieval buildings, elevations and plans

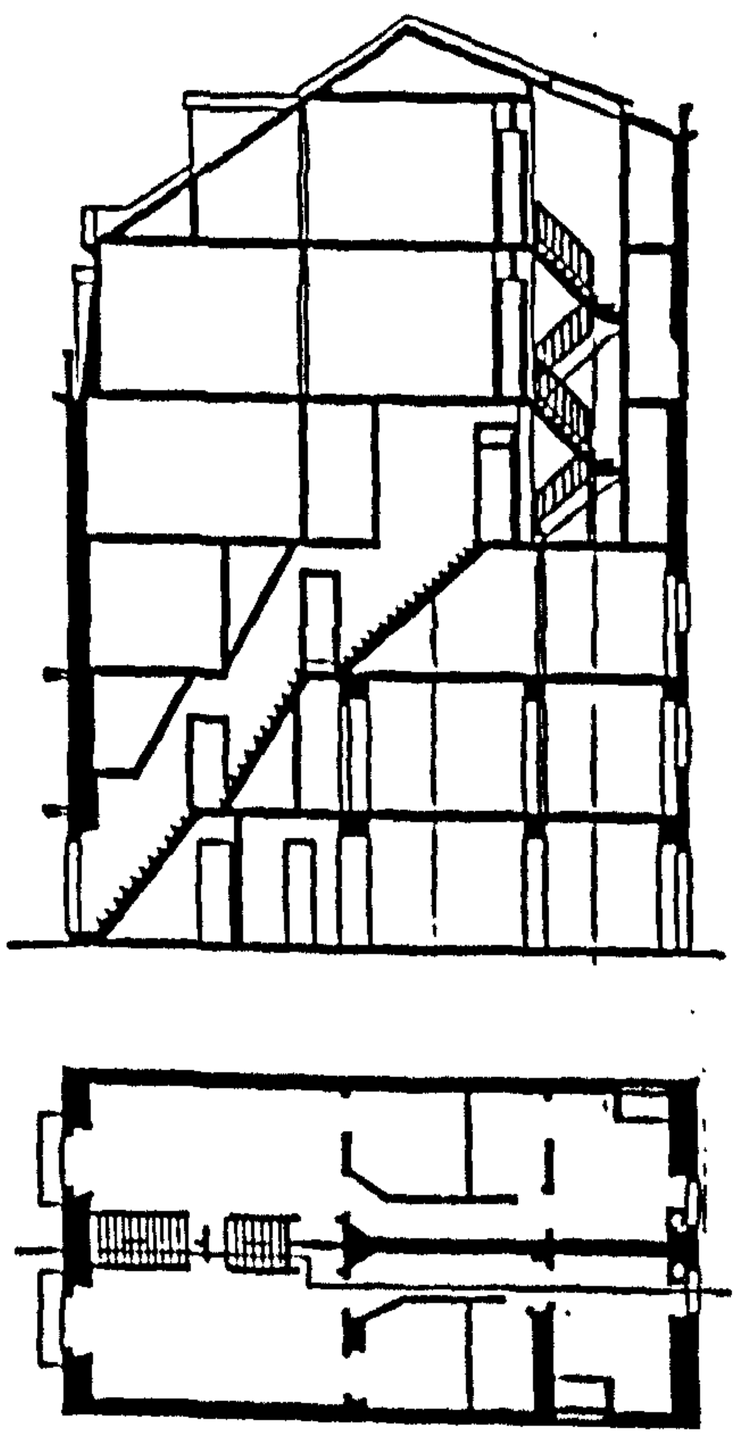


Fig.278-Medieval building, section and plan

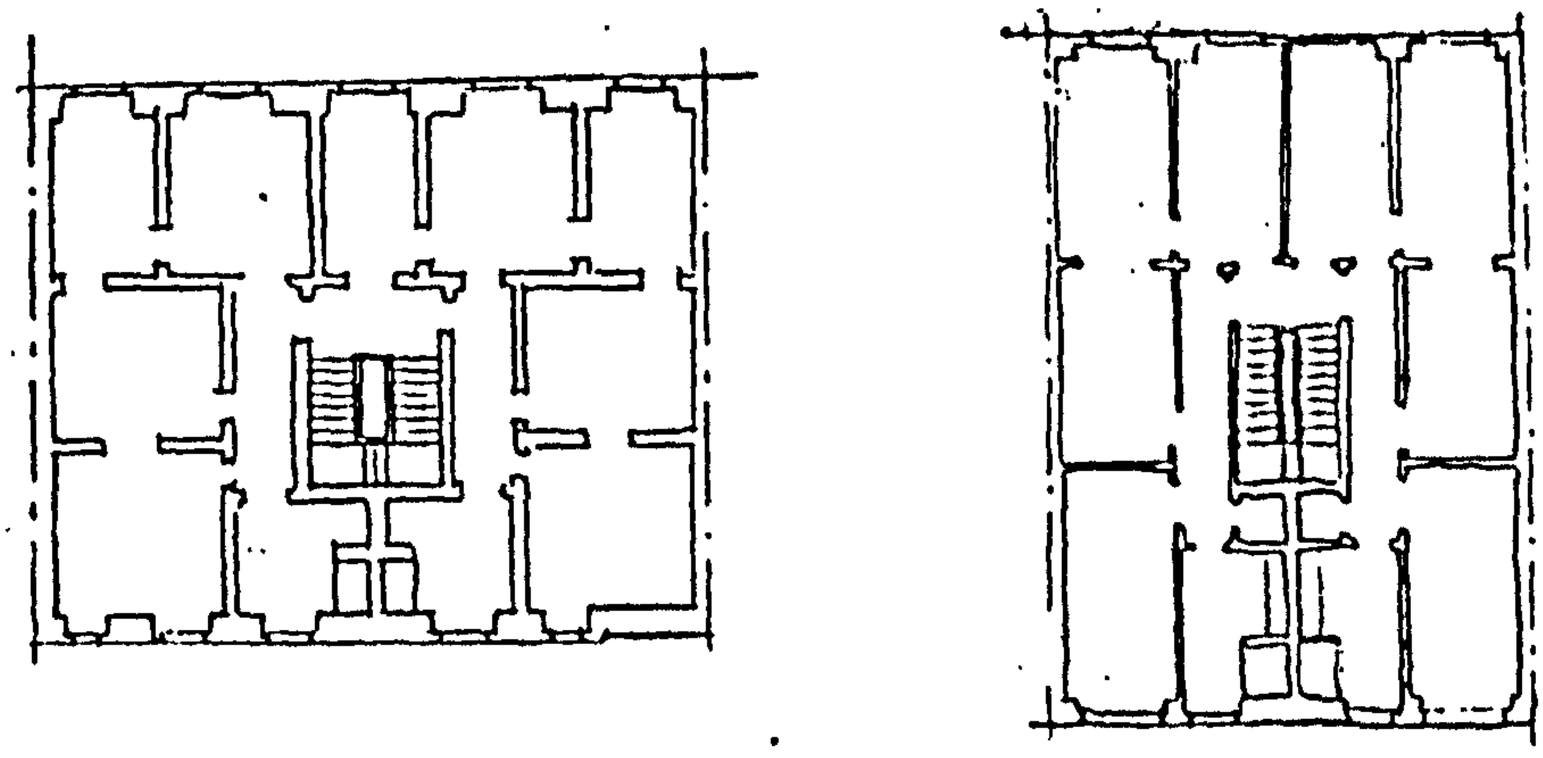


Fig.279-Pombaline building plan and a recent (1940-45) plan of a building in Lisbon

For this study Pombaline rentable buildings were selected with two homes per level "Left/right", with the advantage of being able to confirm if there had been specific alterations later on in the case of one of the pair of flats not being exactly the same as the other. In the flats which have one flat per stair, the types of stairs present still conform with the seven types classified in section III.2.4..

As we saw previously (Chapter IV) each flat comprises three rows of rooms parallel to the façade, (see Fig.280): The first, immediately behind the street façade, consisted of the most important rooms in the flat: the living room and the dining room. The second, an interior row, with no natural light or ventilation contained the bedrooms and the third row, next to the internal courtyard façade, was where the kitchen was normally positioned.

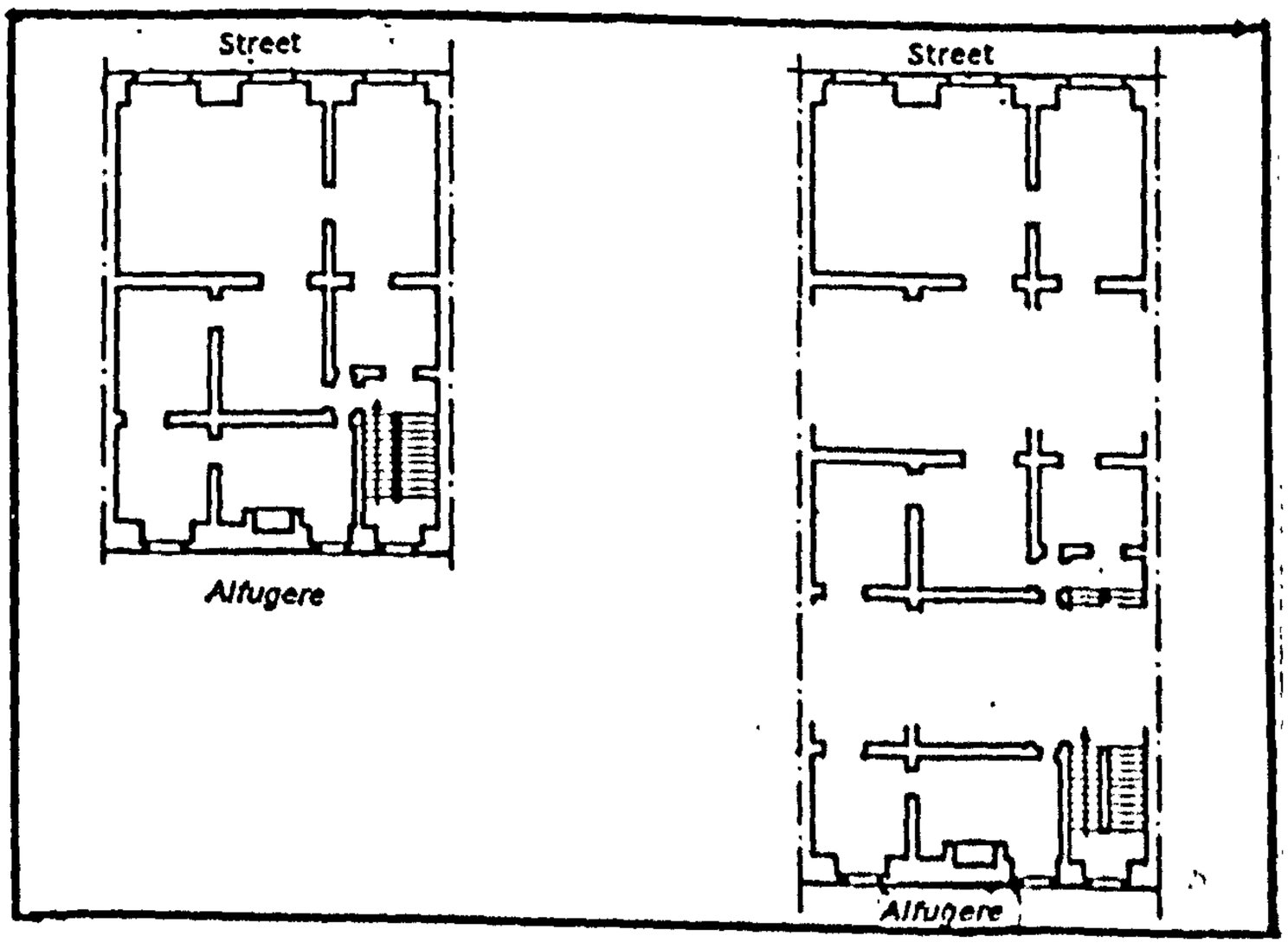


Fig.280-Plan of a flat and the three rows of rooms

To better understand the possible evolution of the plans it is necessary to postulate what was intended by this evolutionary process. It is suggested that in making only one stairway, to gain access to the flats, it was desirable for the purposes of convenience to locate the entrance near both the sitting room and the kitchen. Location of the stairway in the centre of the building would be ideal, but this would create problems due to the necessity to illuminate it with an expensive and complex skylight. Locating the stairway behind the façades would make it easy to provide illumination by windows, but then the stairway would be far from the kitchen or far from the sitting room. There appear to have been different phases, in which attempts were made to solve this problem. This was thought to start with the stair behind the street façade, which was usual in medieval areas of Lisbon, then moving the stairway progressively to the rear of the building and ending with the stairway in the centre of the building, a solution very common in Portugal even today. The particular types and subtypes, (where in some cases elaborated solutions can be identified), were originally thought to be part of an evolutionary process. The suggested evolutionary sequence of types is presented schematically in Figure 281.

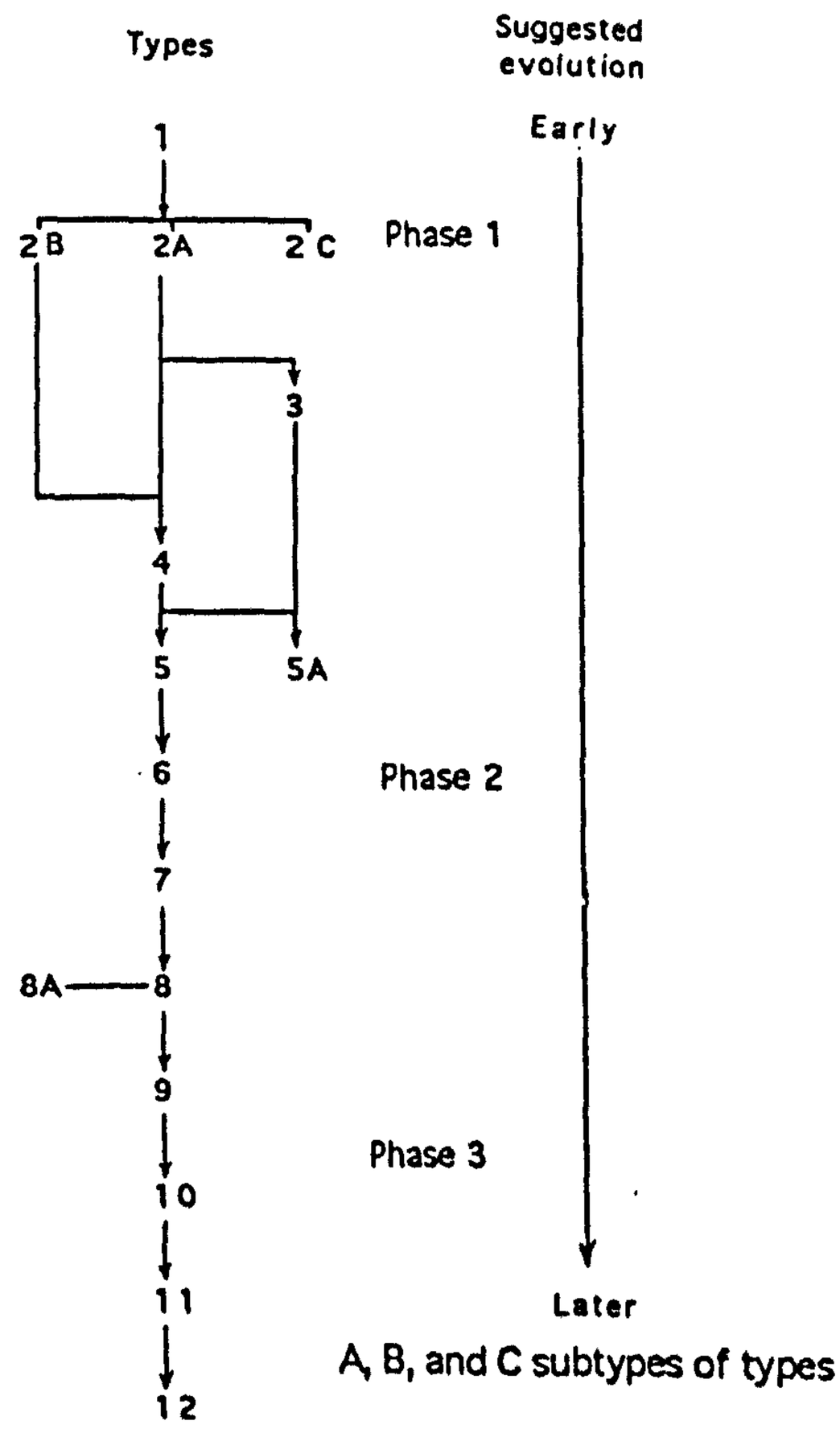


Fig. 281-Suggested sequence of evolution of plans

A, B, and C subtypes of types

The proposed types are described in the following sections as three phases.

V.2.1. The first phase, stairs at the front, types 1, 2 and 3.

Type 1: In type 1, the stairs were built to a very simple design. They climbed alongside a wall and were positioned next to the street façade, reaching the first floor in a single flight, with no landings in between, as is the arrangement in buildings in medieval areas of Lisbon. The internal subdivision of the flats was very basic and there was no interlinking corridor. The doors were generally central in the partitions, (see example in Fig.282).

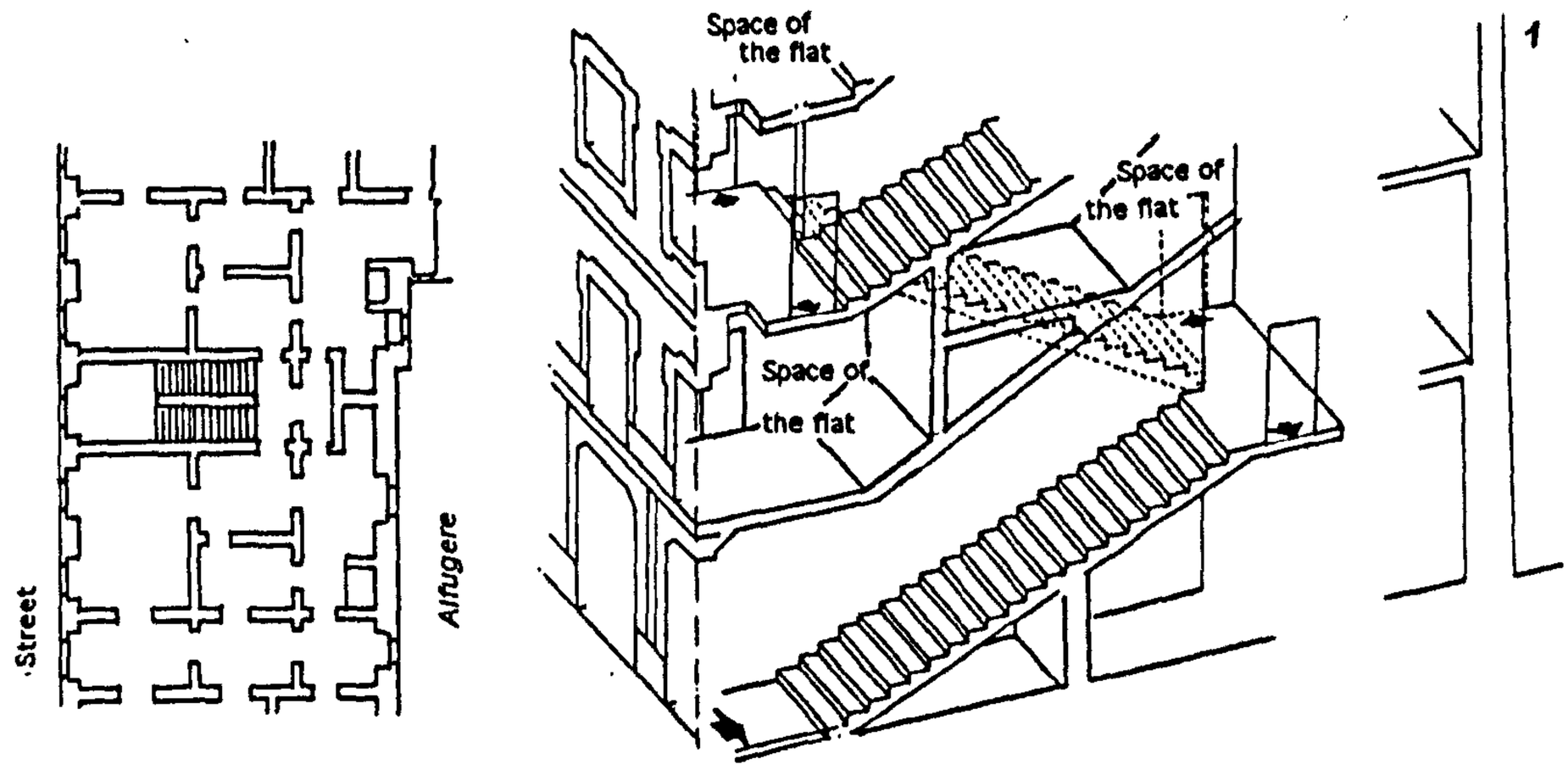


Fig.282-Typical plan of first type and a typical section

It is interesting to note that when Manuel da Maia suggested the street width (see section I.8.3) he presented a plan of a street and partial plans of the adjacent buildings in which the stair is next to the street façade similar to the above example (see Fig.283)[21]. This suggests that this was a common arrangement at that time and would probably have been used in the early buildings.

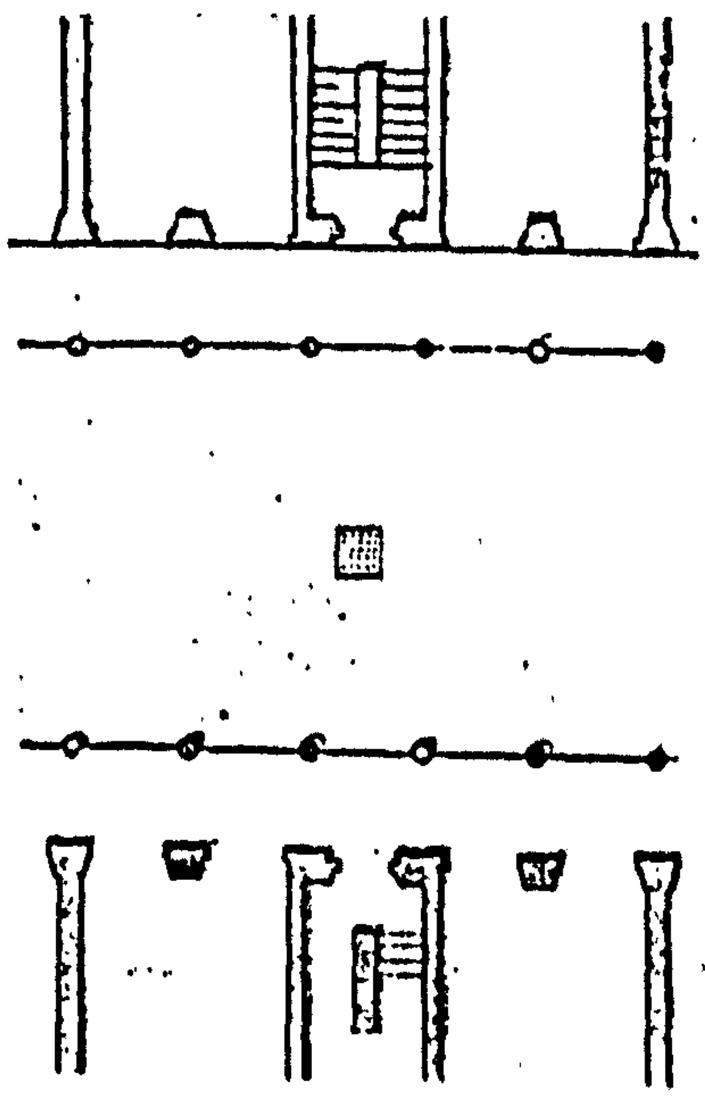


Fig.283-Drawing presented by Manuel da Maia suggesting the width for the streets

There were a number of advantages and disadvantages associated with this design. The positioning of the stair next to the street façade eliminated the need for a skylight, which was both difficult to instal and costly. Also in the event of fire, the rescue of the inhabitants could easily be carried out through the stair windows, which would also disperse smoke. On the ground floor, the shop could operate freely behind the stairs without interruption.

However the flats lost a window on each floor overlooking the street because of the stairs, and the entrance to the flats on alternate floors was immediately behind the street façade, which created problems in the internal arrangement of the flats. For example, the entrance was too far from the kitchen, and the internal arrangement was different on different levels in that the space left beneath the stairs on alternate levels was owned by only one of the flats.

Type 2: In order to overcome this last problem, in the second type three alternatives were created.

Sub-type 2A: Dogleg stairs were used so that all the flats were similar, but with the inconvenience of the entrance being far from the kitchen, (Fig.284).

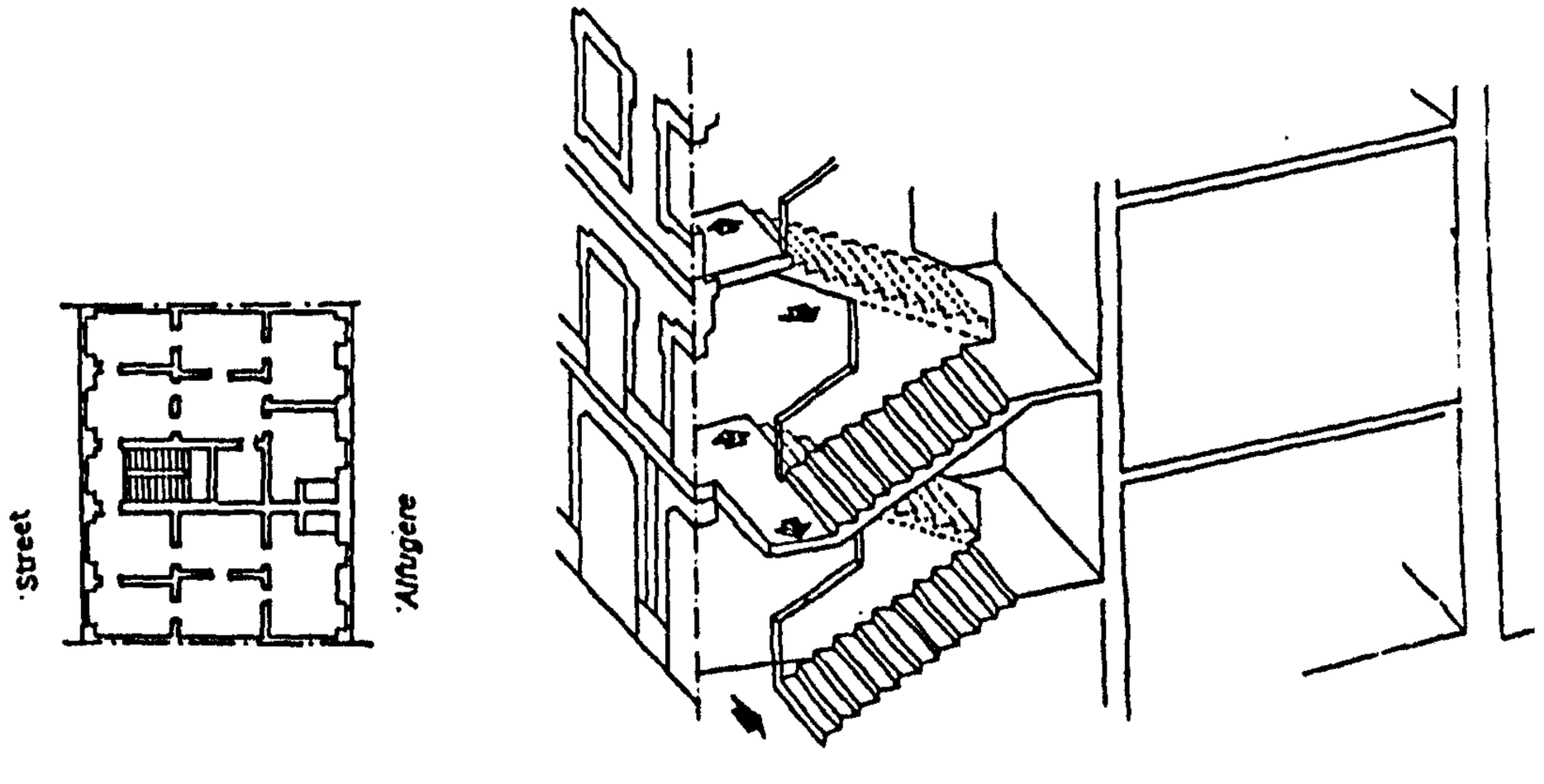
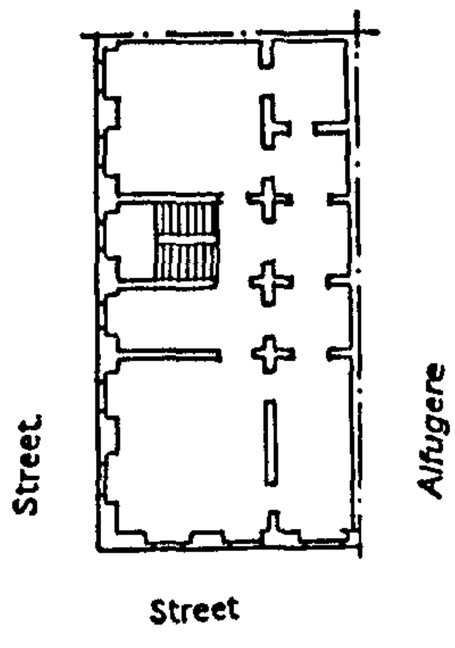


Fig.284- Examples of plans and a typical section for type 2A

Sub type 2B: As in 2A but the entrances to the flats were positioned in the centre of the building, next to the kitchen.

However, this device was not suitable for the Pombaline buildings where the windows are strictly aligned horizontally and vertically, because the landings are no longer in synchrony with the windows which have to open onto the stairs, (see Fig.285).



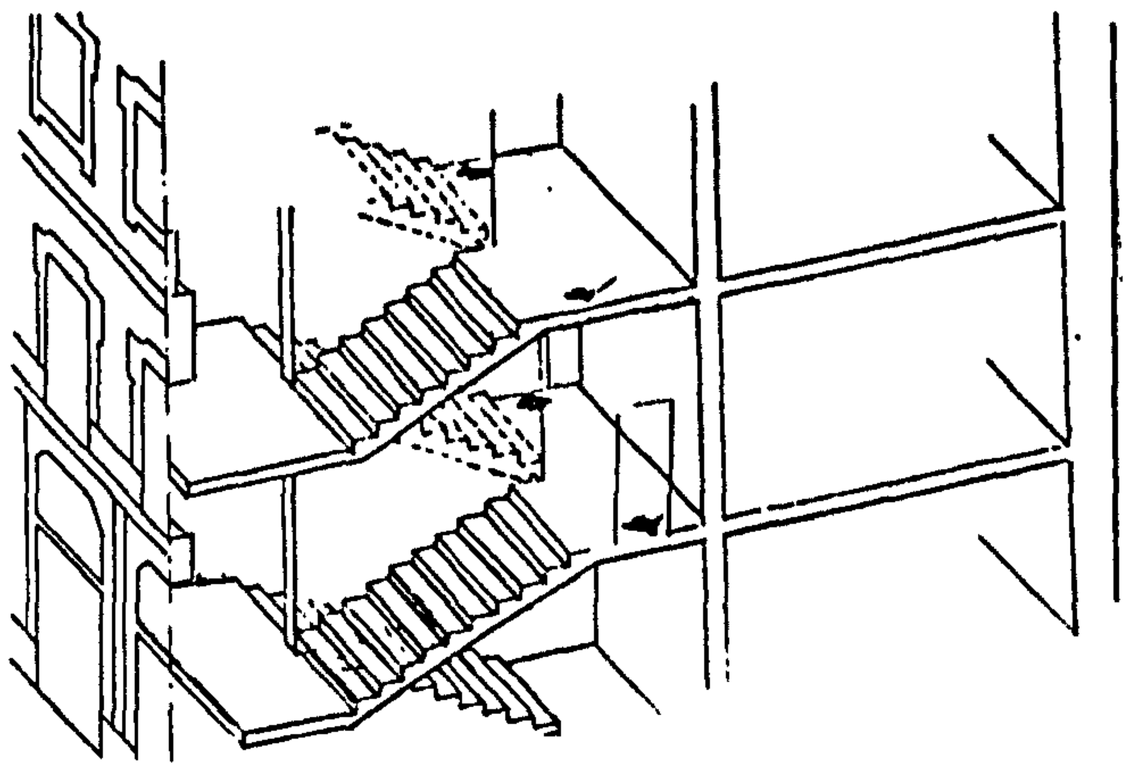
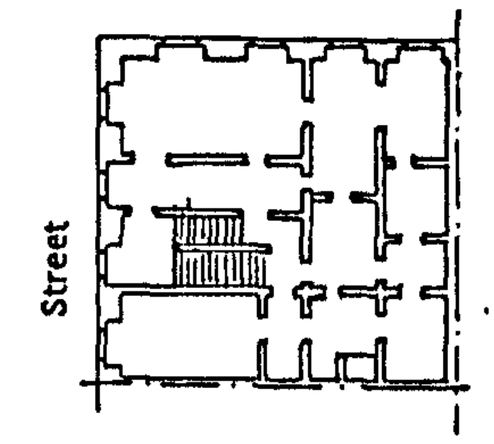
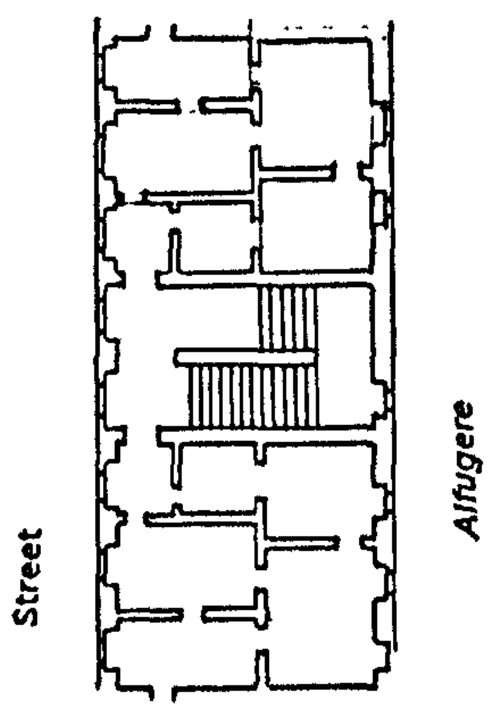


Fig.285- Example of plans and a typical section for type 2B

Sub-type 2C: Here the intermediate landings were immediately behind the façades, but as it was not possible to align the landings with the windows, another solution was created, a stair with a long landing, which allowed entrances in the centre of the flat. However this made the way of escape much longer in case of fire and the stairs were therefore protected with vaults made from stone, which was a more elaborate and expensive solution, (Fig.286)





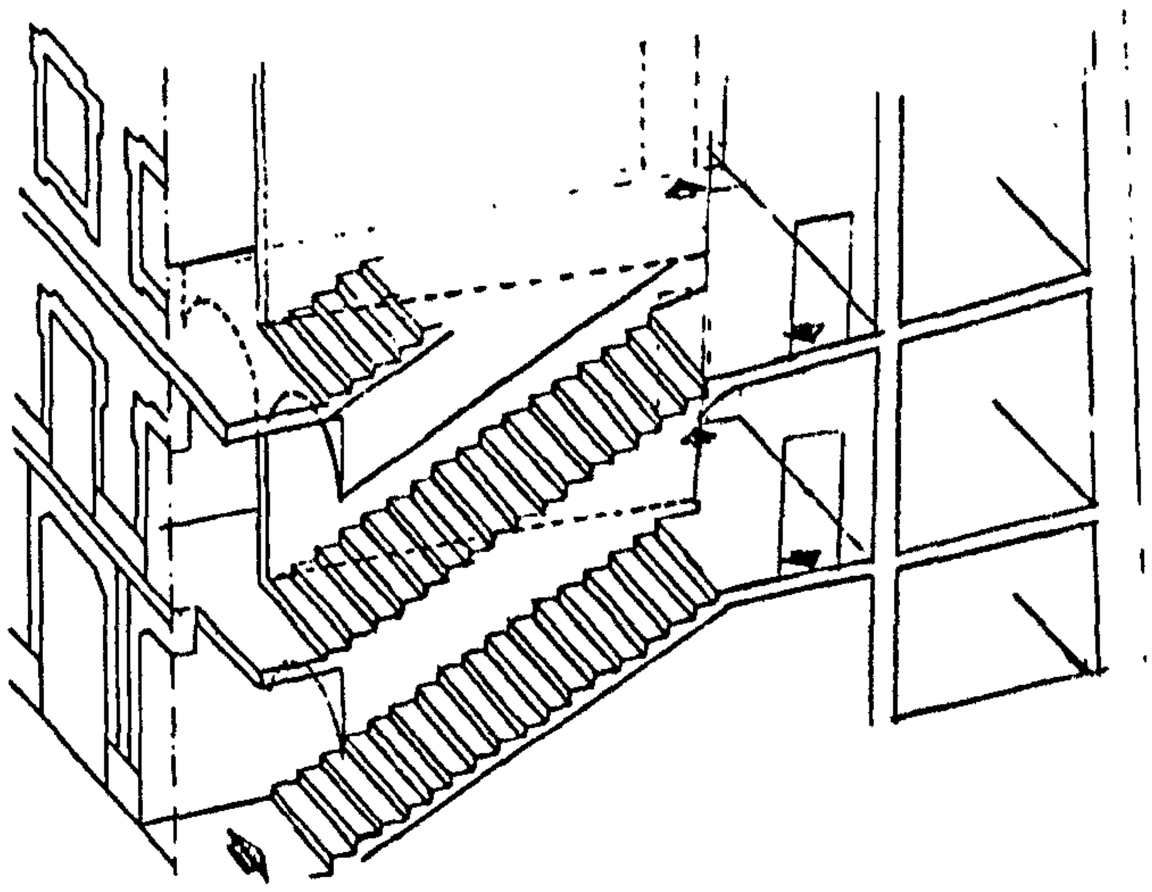


Fig.286- Examples of plans and a typical section for type 2C

Type 3: In the proposed third type dogleg staircases were used with the half-landings at the opposite end from the street façade and the flat entrances next to it, (see Fig.287).

Access to the kitchens is via a special flight of stairs which rises from the half-landing. However this must have increased construction costs.

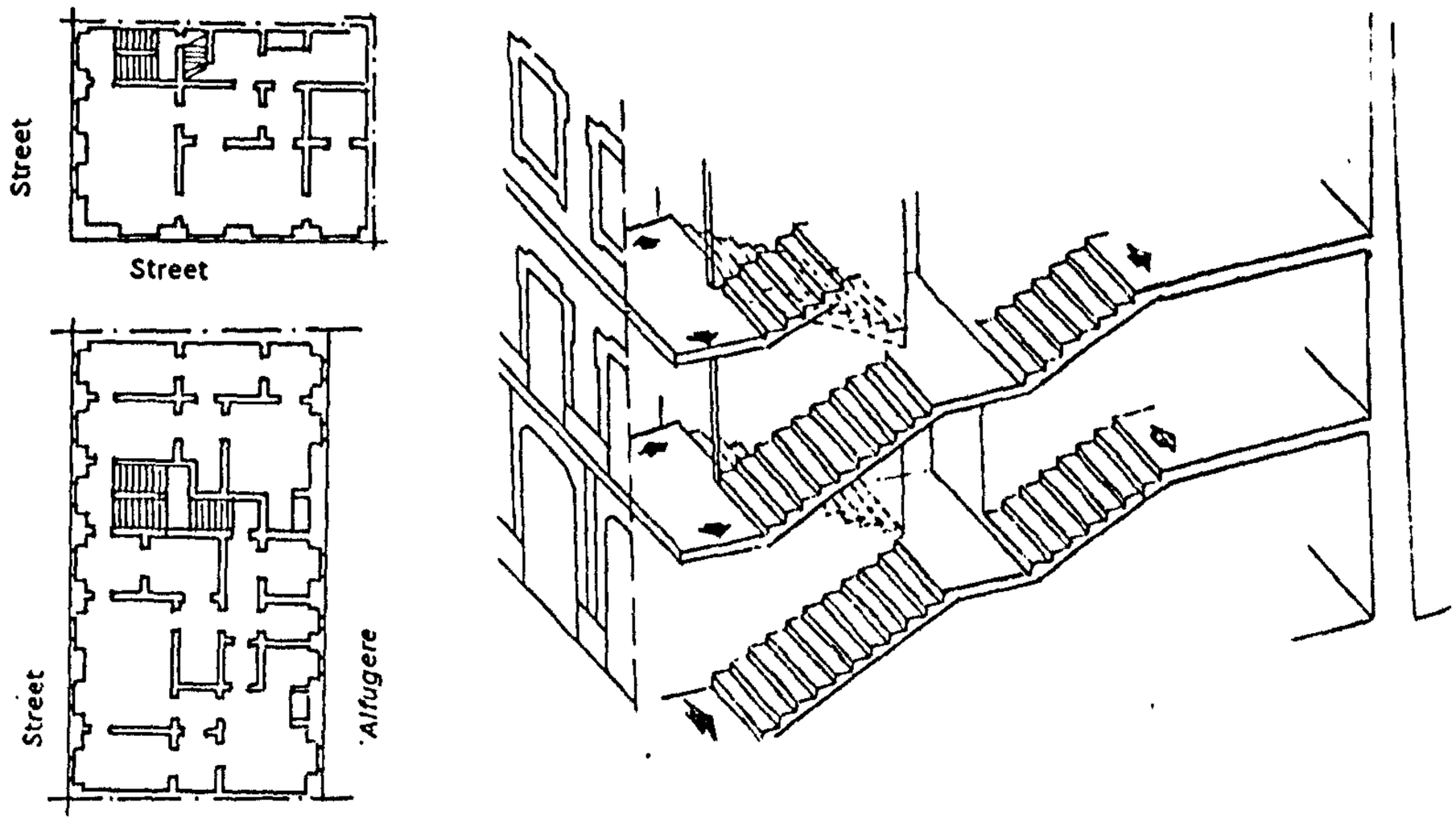


Fig.287- Examples of plans and a typical section for type 3

V.2.2. The second phase, stairs at the rear, types, 4, 5, 6, 7 and 8.

Type 4: In this type the stairs begin from the street façade with a straight flight rising to a landing at first floor level in the centre of the building. Thereafter the stairs are doglegs similar to type 2A but with half landings on the *alfugere* façade and landings in the centre of the building, (see Fig.288). In one case the staircase is a newel rather than a dogleg arrangement.

This meant that the system of construction of the stairs was complex and the flats on the first floor lost space to the stairs both at the back and at the front. Also the accommodation in the first floor flats differed from that in the other flats, which made this system more complicated to build.

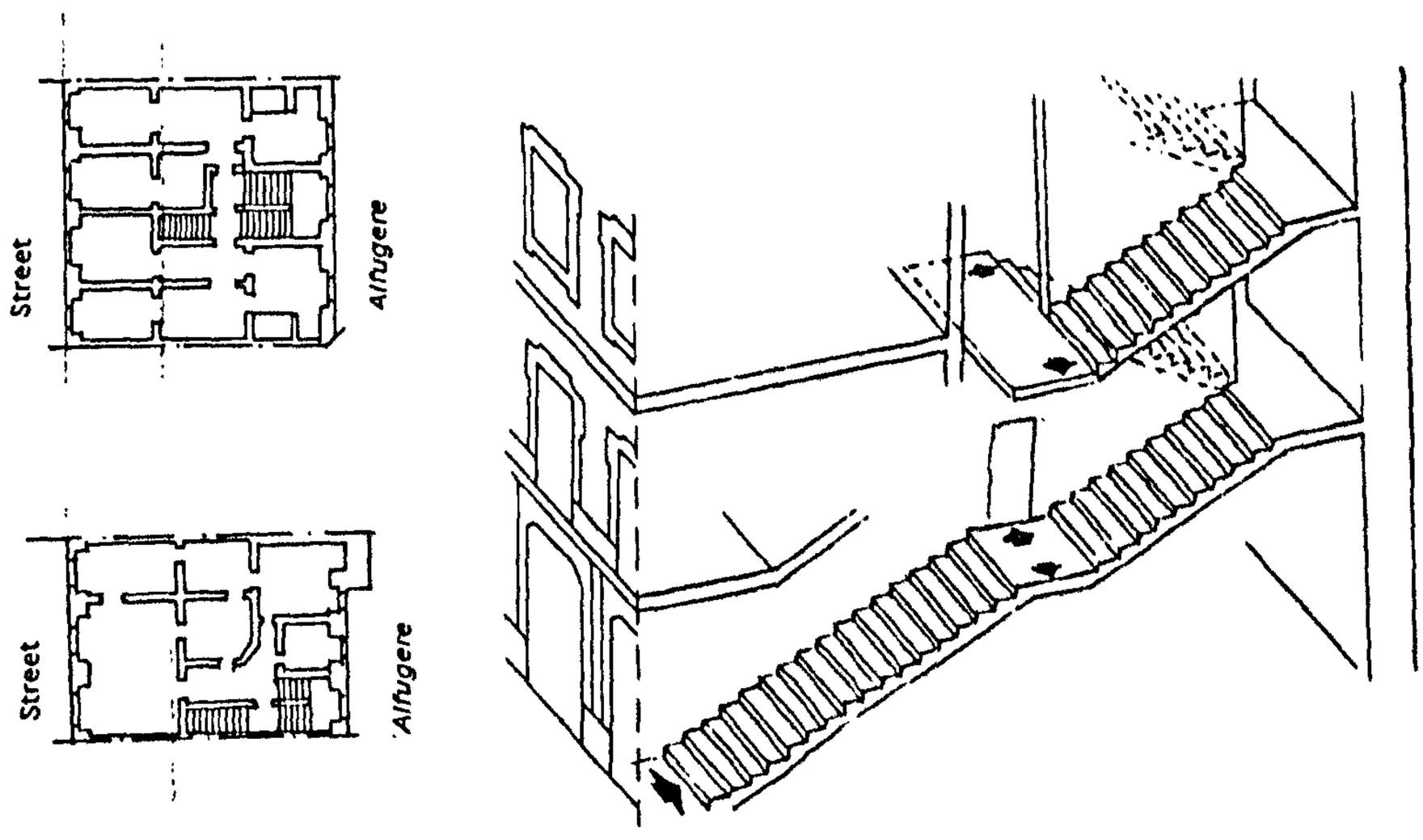


Fig.288- Examples of plans and a typical section for type 4

Type 5: The fifth type marks a very distinct type as it seems to be the culmination of a process in which the stairways have moved from the front of the building as in type one to the rear of the building in this type. Thus in this type the stairs climb all the way up next to the *alfugere* (courtyard) façade, in contrast to type one where they climb up adjacent to the street façade, (see Fig.289).

This simplified the stair construction and meant that the flats had rooms backing onto the stairs with windows facing onto the street.

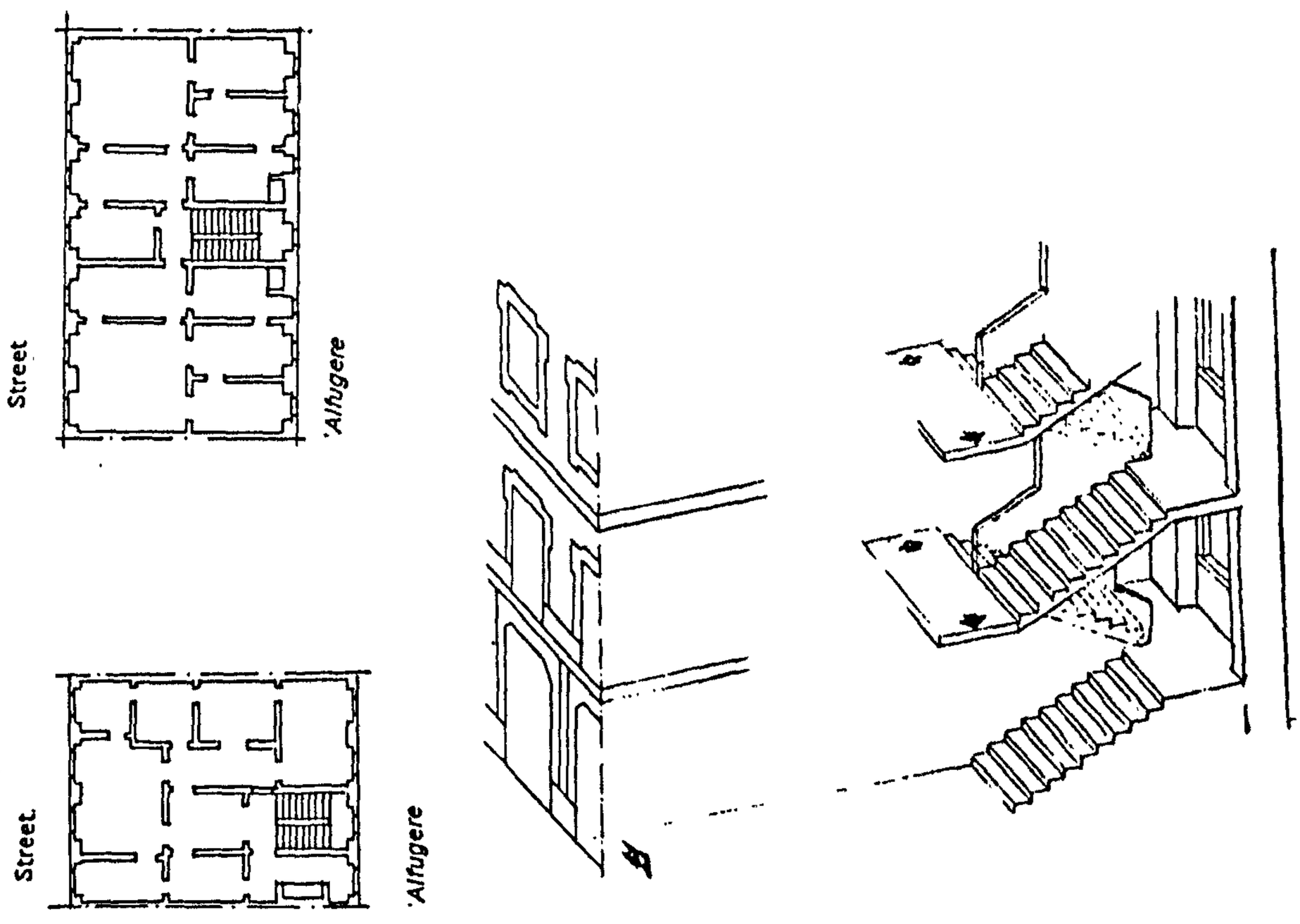


Fig.289- Examples of plans and a typical section for type 5

However access from the street to the stairs was via a narrow corridor which divided the shop space into two. Also the room facing the stairs was too deep, unless it was divided into two, in which case one of the rooms was internal with no windows. There is also a variation of type five, sub-type 5A in which access to the kitchen is via a special flight of stairs. However this more elaborate design must have been expensive. It was used in Arsenal street and on top of blocks where the properties are not as deep, (Fig.290).

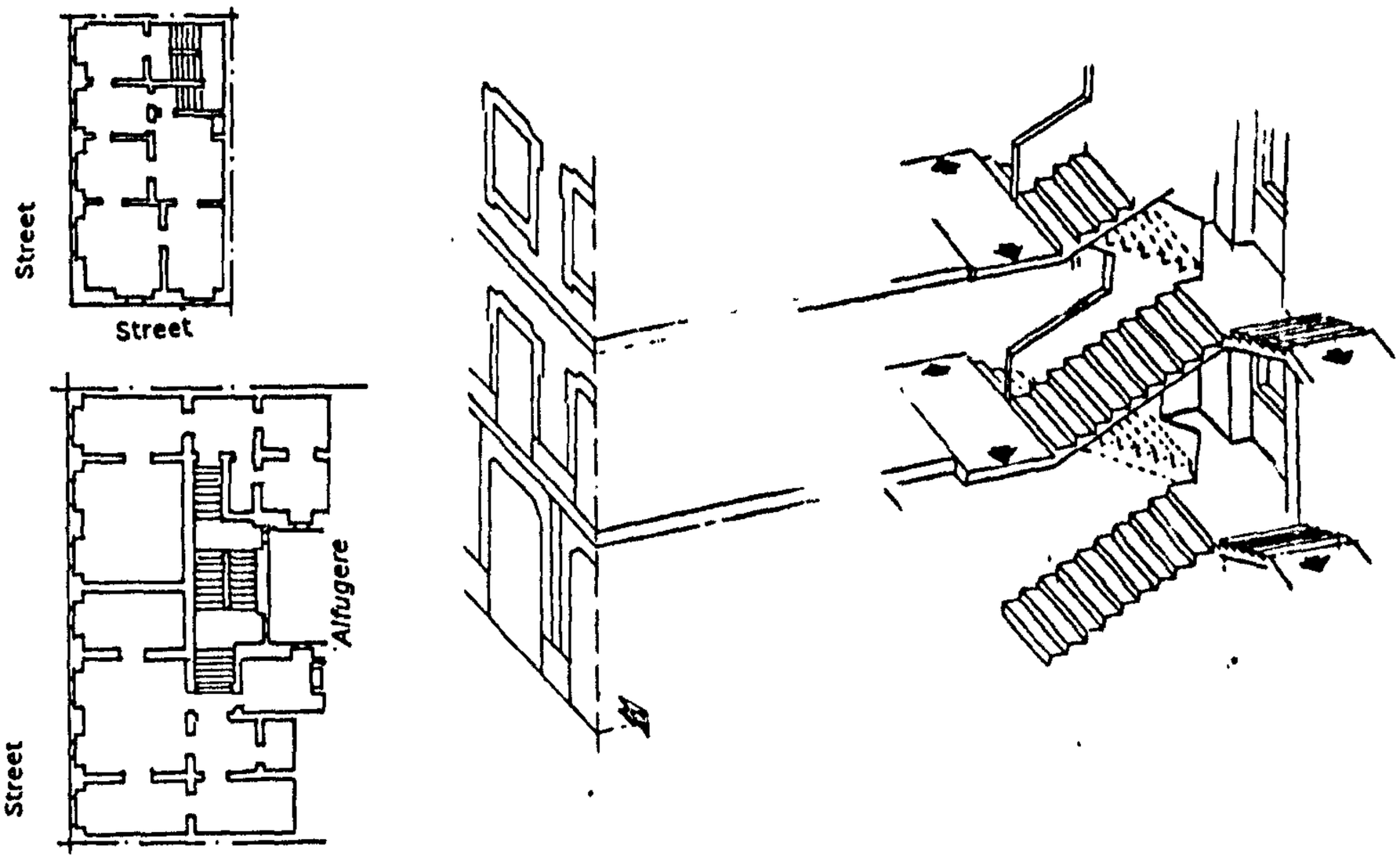


Fig.290- Examples of plans and a typical section for type 5A

Type 6: This type appears to be a modification of type 5, in which the stairs were brought slightly forward drawing part of the alfugere to within the perimeter of the building, (see Fig.291). It is thought that this was done in order to connect the two shops on the ground level and place the entrance to the flats more in the centre of the building preventing the need to subdivide the sitting room which was opposite the stairs.

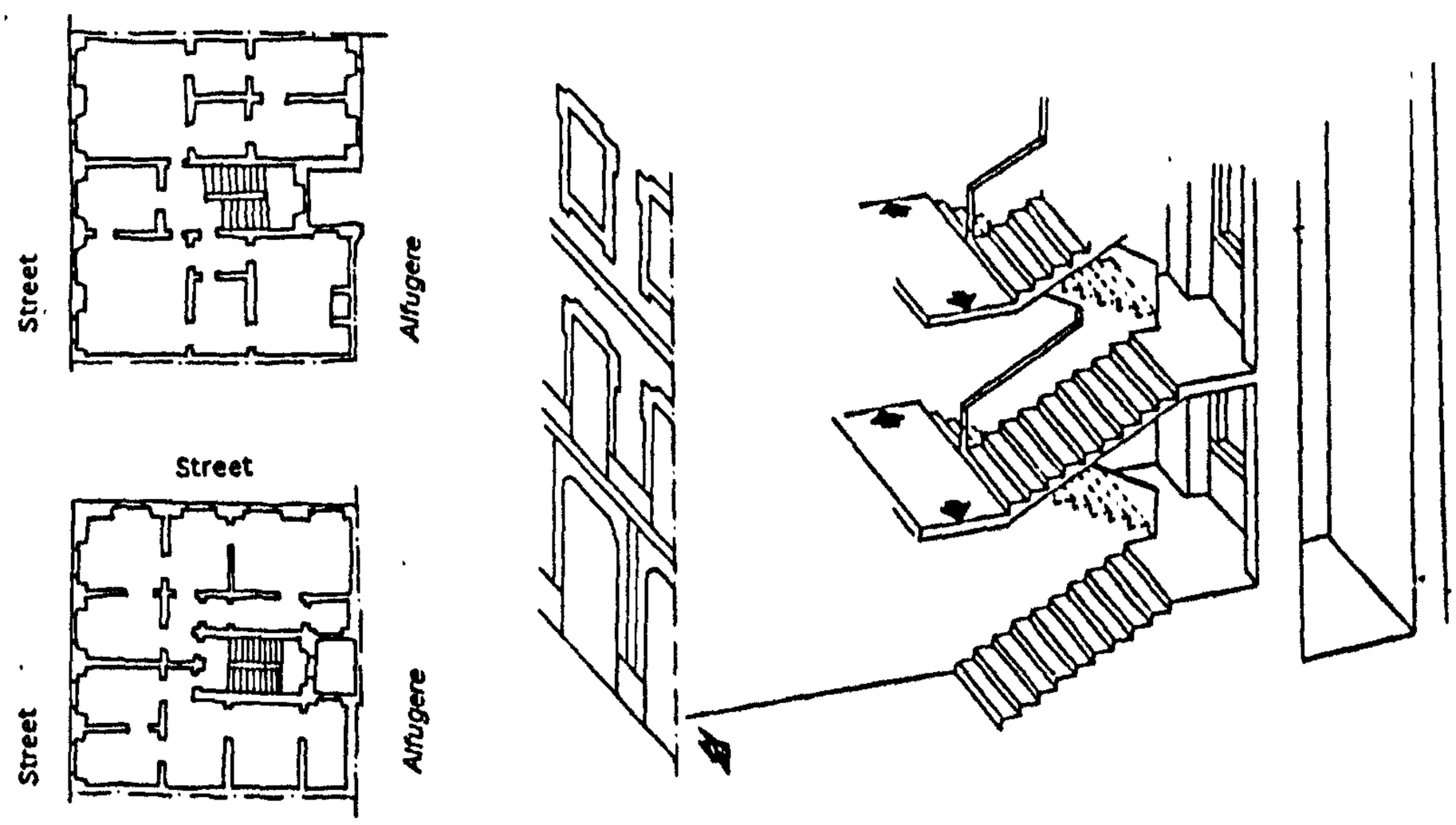


Fig.291- Examples of plans and a typical section for type 6

Type 7: Type seven appears to be a further development in which the windows which open onto the intermediate landings became deeper, (Fig.292).

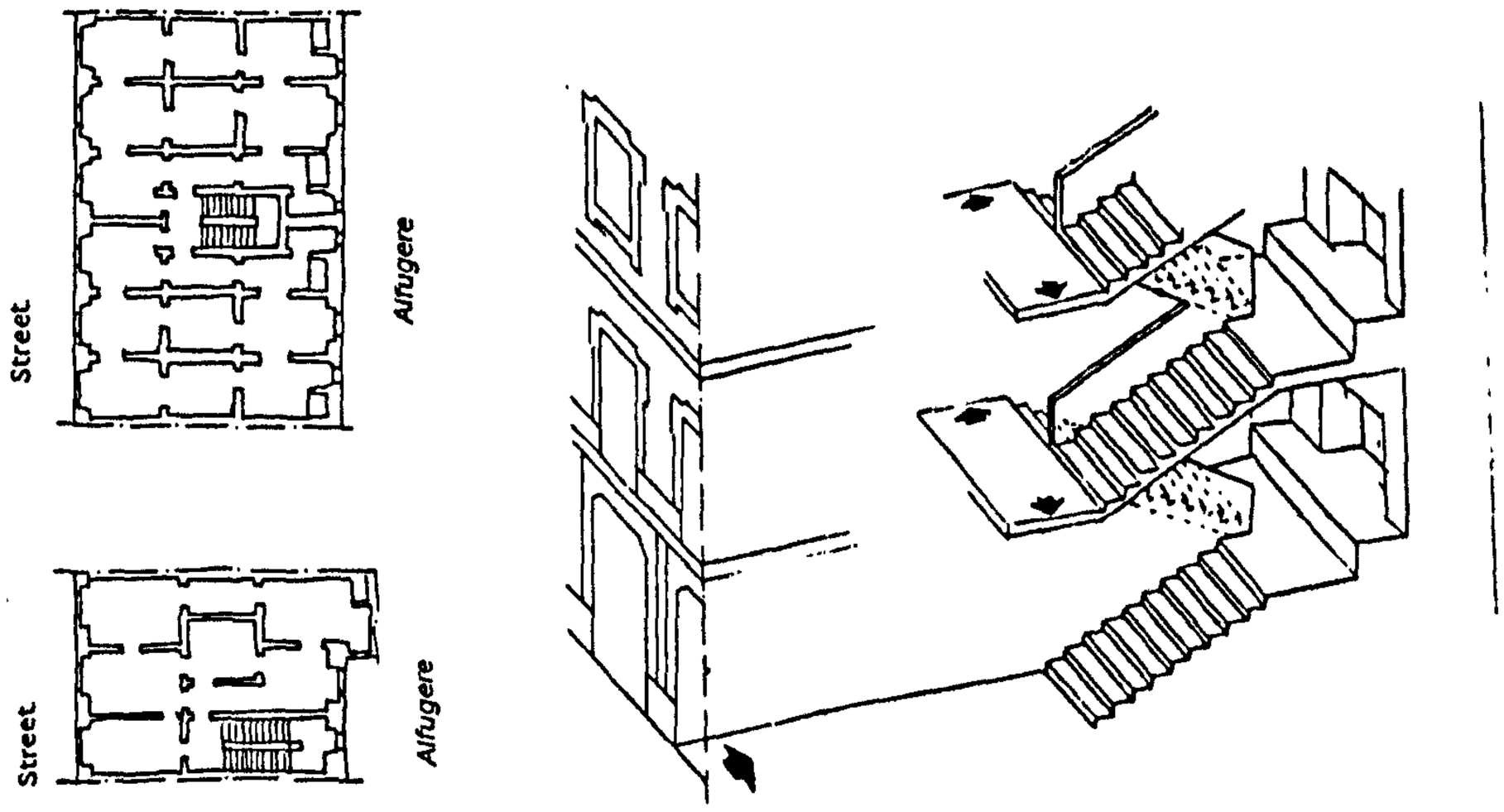


Fig.292- Examples of plans and a typical section for type 7

Type 8: This type appears to represent yet a further development in which cupboards were constructed in the extra space created in front of the landing windows, which were then blocked off, making the stairs dark. This meant that a skylight had to be installed above the stairs which must have added extra cost, (see Fig.293). It is clear however that this change was not effected by modifying existing buildings, because this type also represents a distinct modification in internal design. For the first time the doors are placed not along the axis of the rooms but in the corners.

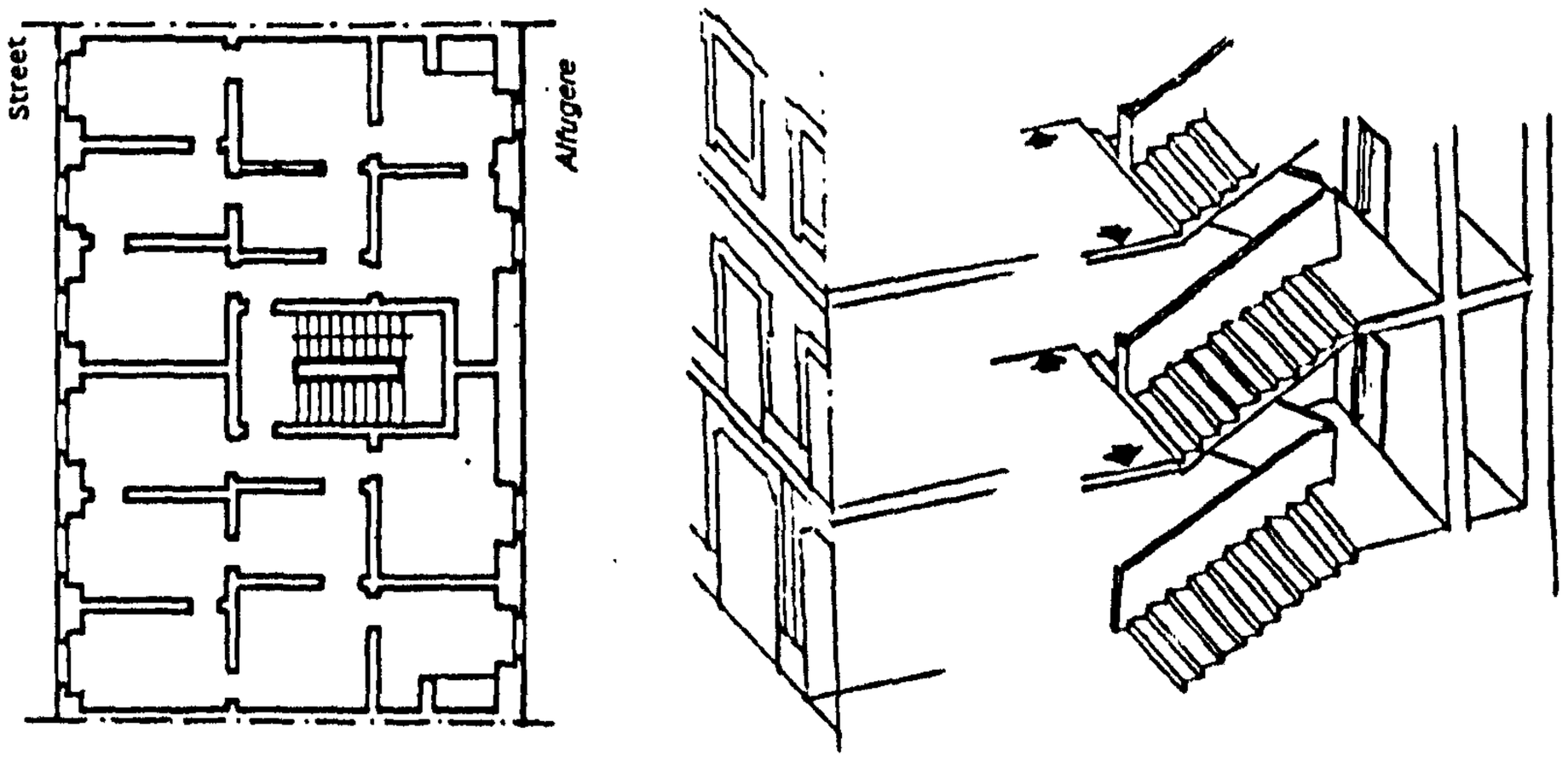


Fig.293- Examples of plans and a typical section for type 8

Type 8A is a variation of type 8 in which the stairs are moved noticeably closer to the interior of the building, with the space behind the stairs being used in some cases to install a kitchen fireplace, (see Fig.294).

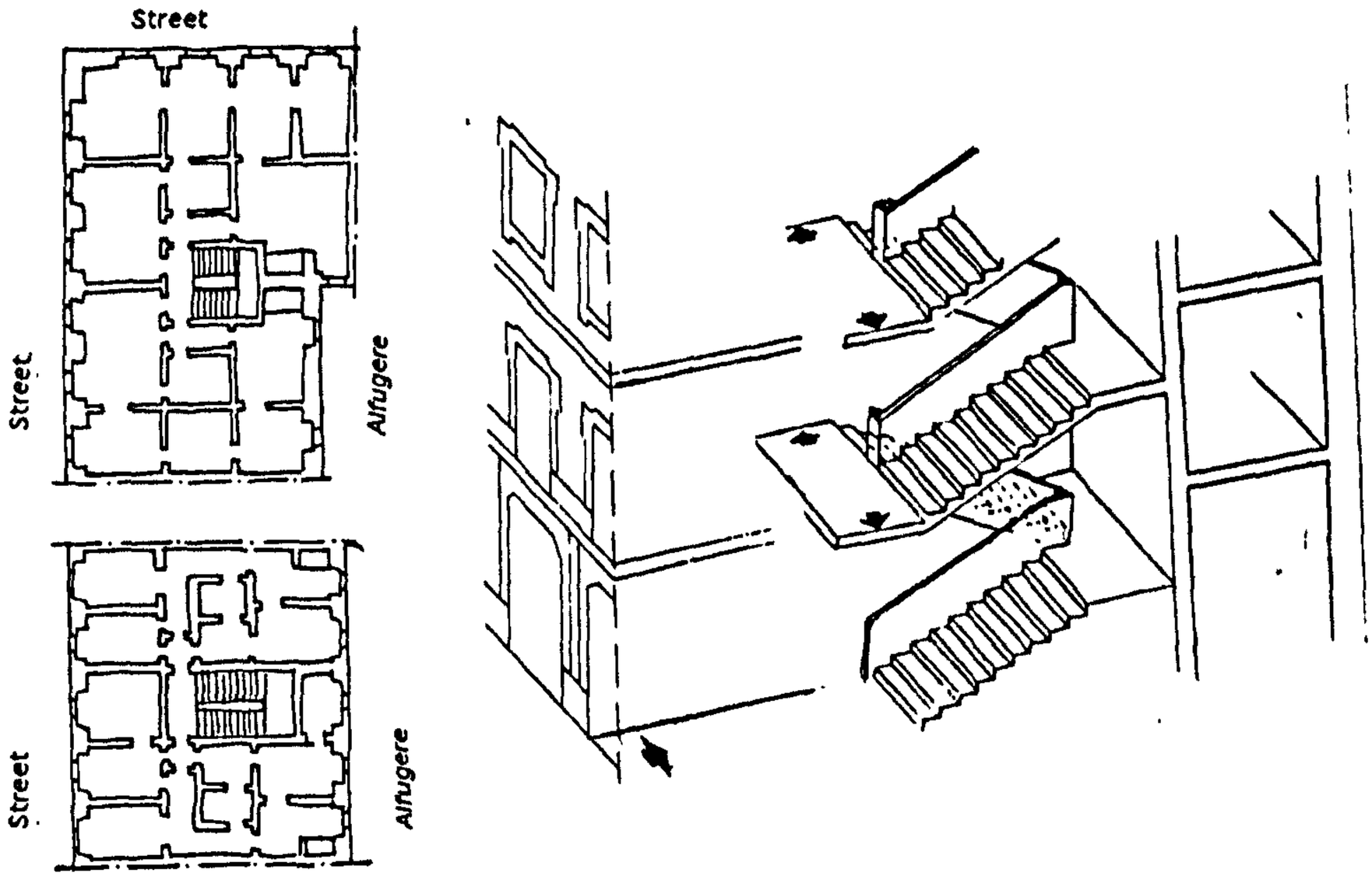


Fig.294- Examples of plans and a typical section for type 8A

V.2.3. The third phase, stairs in the centre, types, 9, 10, 11 and 12.

Type 9: In this type the stairs are located at the centre of the building with a glass skylight above to provide light and with an open newel around which the stairs rise, (see Fig.295). The space between the stairwell and the wall of the *alfugere* (courtyard) is seen as a useful area for rooms.

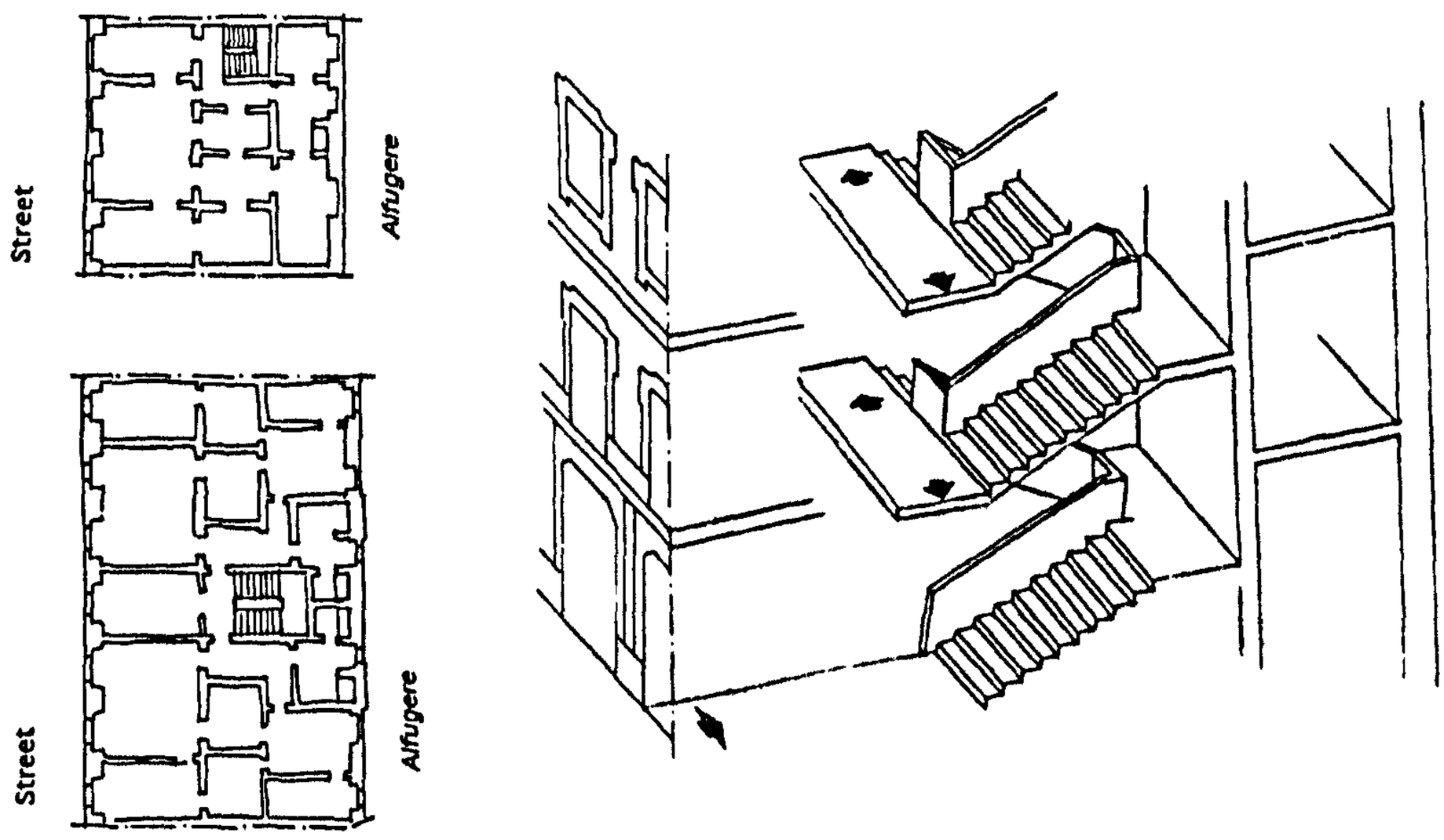


Fig.295- Examples of plans and a typical section for type 9

Type 10: Type ten is a variant of phase 9. In this phase the entrance landing is designed to provide two entrances for one of the flats, one of which is near to the kitchen, (Fig.296), and the kitchen is moved closer to the entrance.

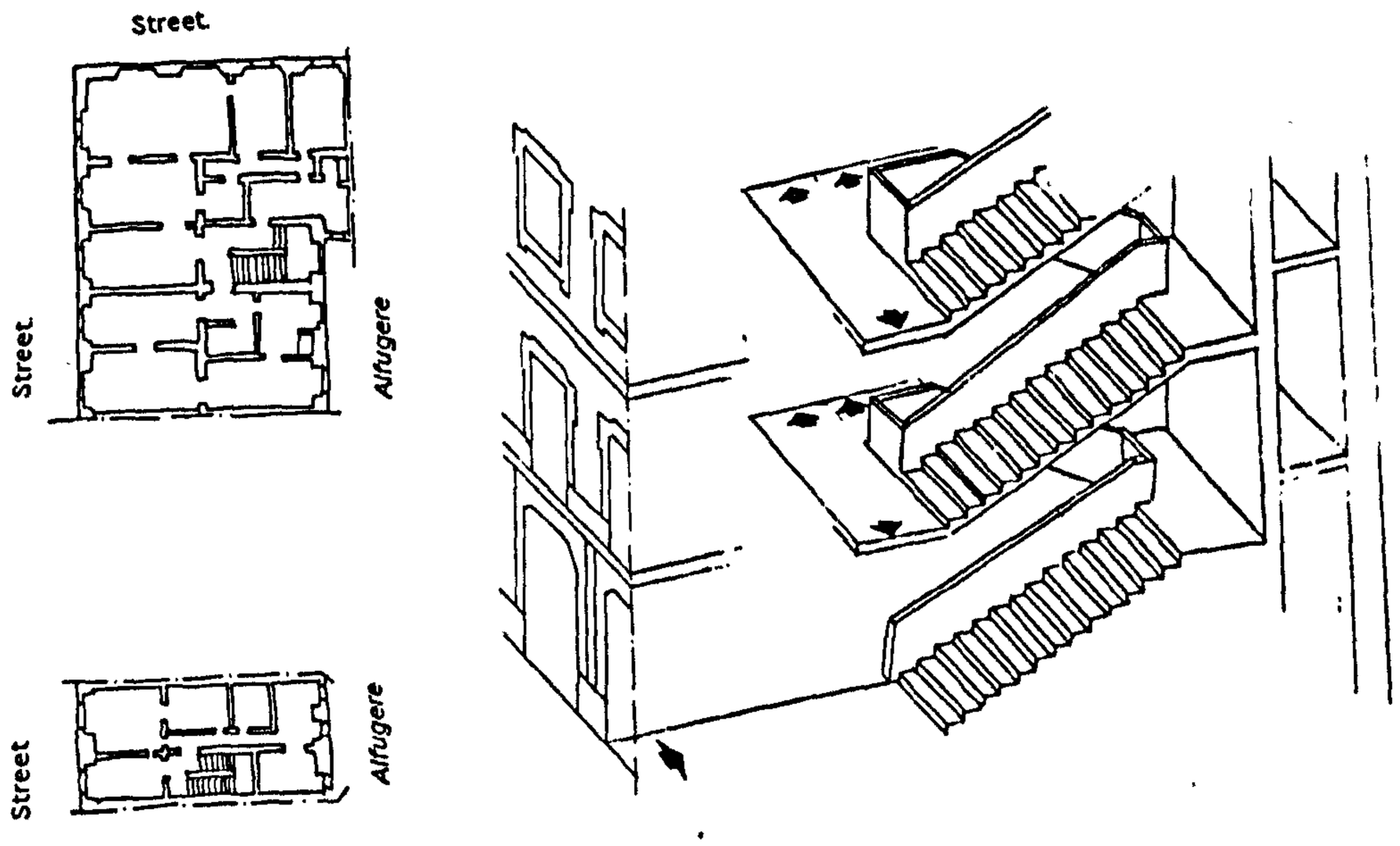


Fig.296- Examples of plans and a typical section for type 10

Type 11: In this type, the stairs still remain at the centre of the building but the central row of rooms become narrower and the stairs much more complex. The height between adjacent floors is spanned by three flights of stairs each rotated by 90°, the 360° rotation being completed by the landing leading to the doors of two adjacent flats, (Fig.297).

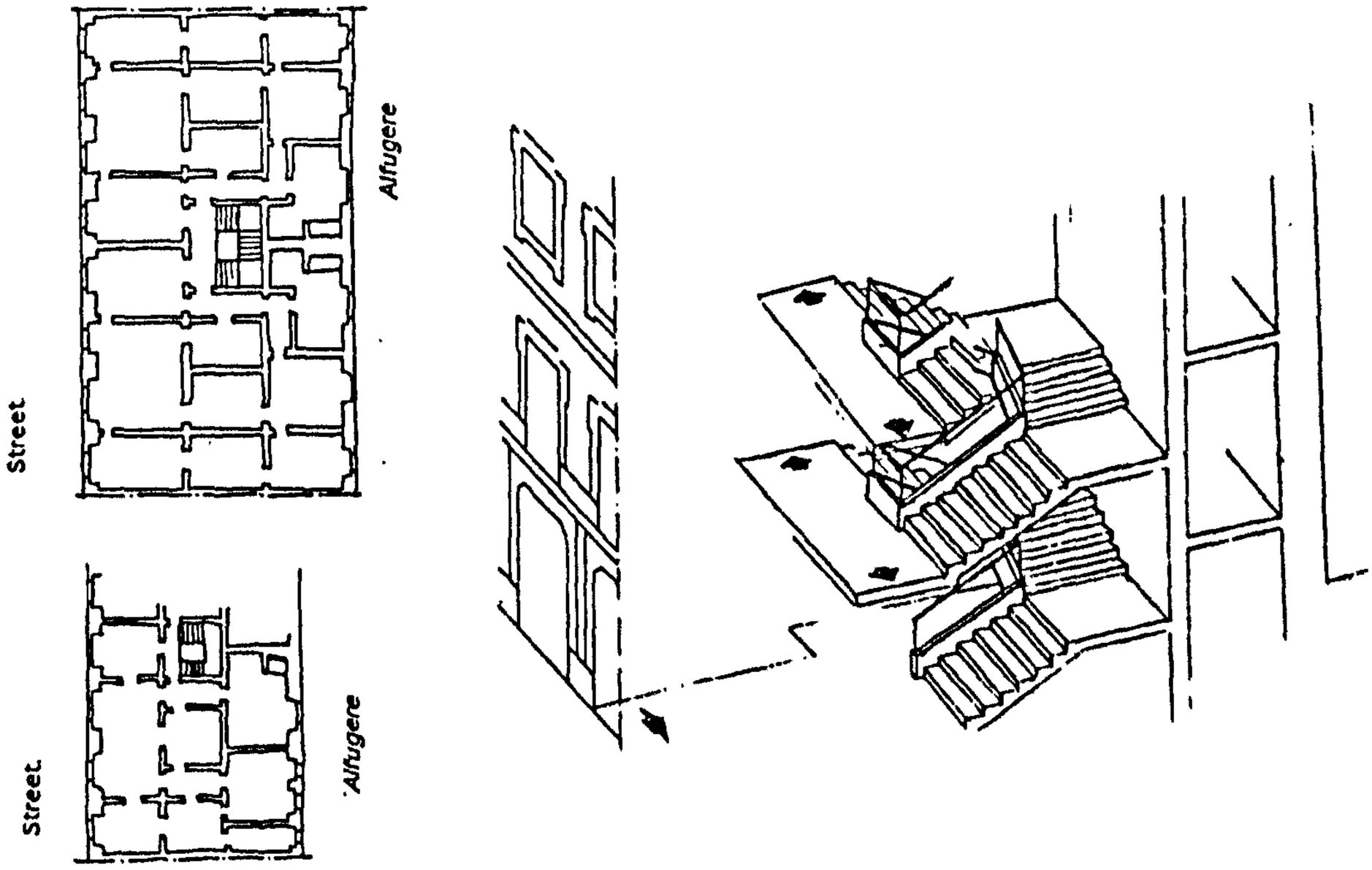


Fig.297- Examples of plans and a typical section for type 11

Type 12: Type twelve seems to be a development of type eleven in which the three flights of steps between each floor are replaced by a continuous flight of steps forming a 180° half spiral, the full 360° turn again being completed by the landing leading to adjacent flats, (Fig.298).

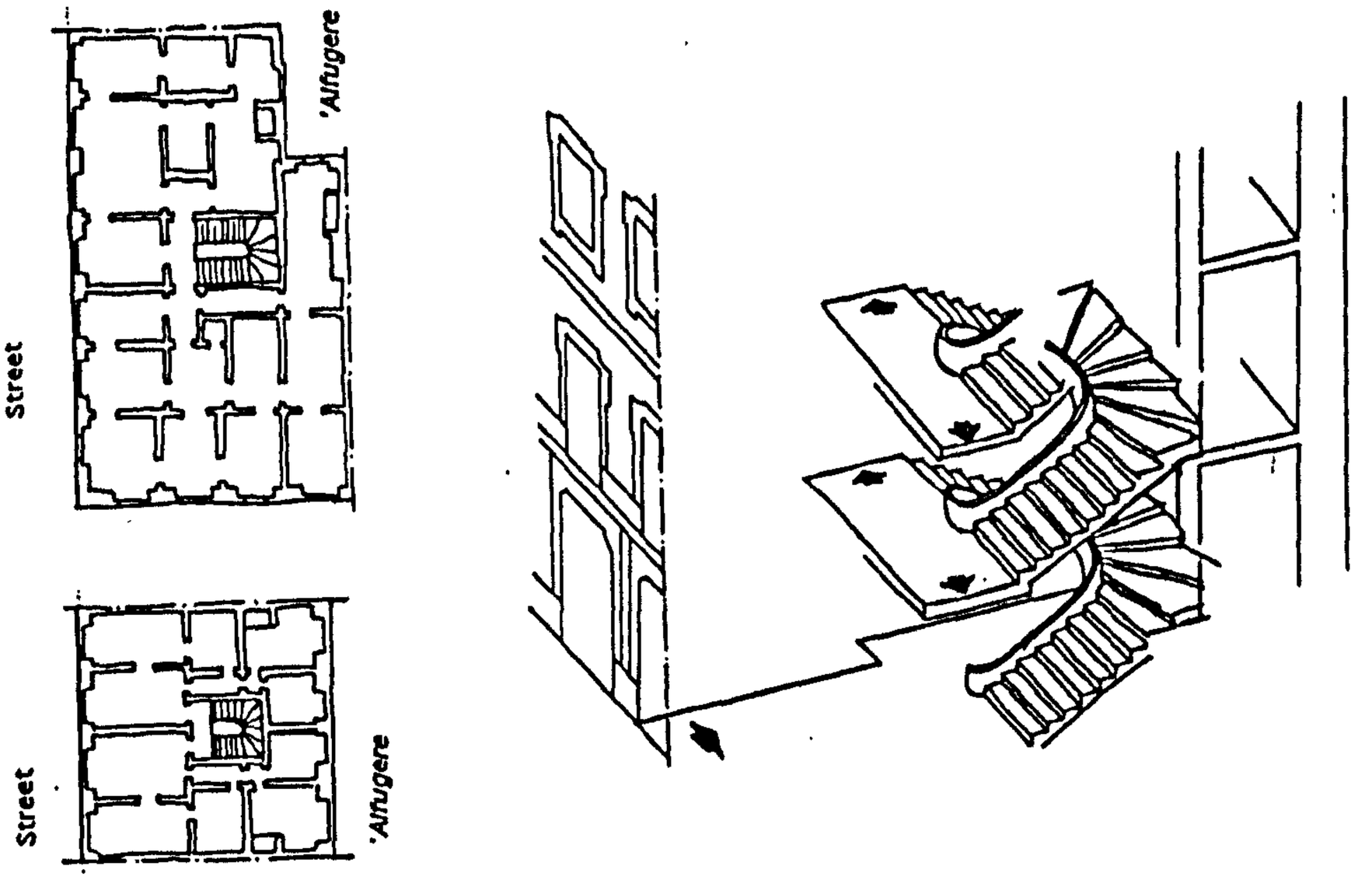


Fig.298- Examples of plans and a typical section for type 12

V.3.Details associated with the various types.

The proposed evolution seemed to be in synchrony with the evolution of the construction process for stairs (see Fig.299).

In types 1, 2B and 2C, the stairs climb alongside a wall, which was simple to build. In type 2A the wall is a "solid" balustrade and in some cases this arrangement persists to type 7. In type 4 in some cases the stairway climbs alongside an open newel, a much more complex situation because it was supported only by two walls. In type 9 the stairs are much more elaborate with three flights per floor and this is maintained in the 10th type. In type 12 the intermediate landings were eliminated and possibly for economy of space, the stairs have a helical form, so they were lit from above by complex skylights that took up little space.

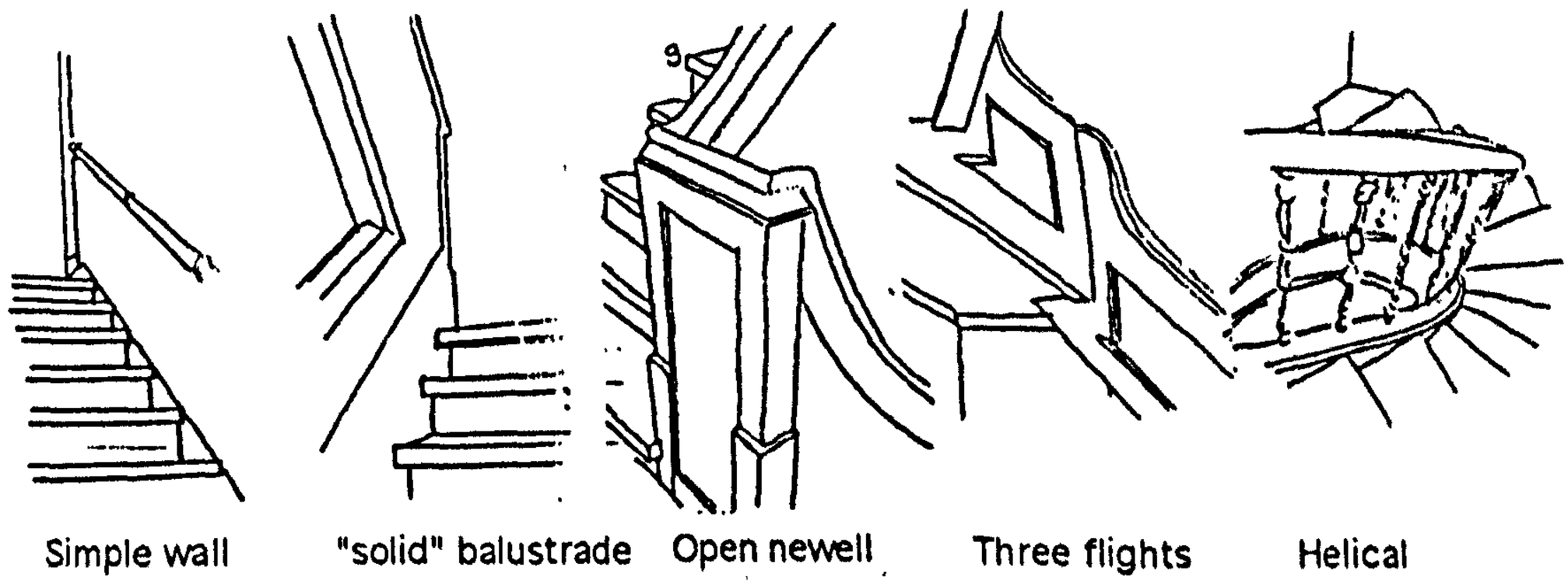


Fig.299-Variations in the complexity of construction of stairs

The records in the building survey of the finishings and construction details associated with the stairs, reveal if there are details which evolved; there are others where their complexity did not increase in a gradual way with the established development and, in some cases, it seemed that the finishes became simpler and even of poorer quality. This did not seem to be restricted by technical availability (for example railings were made of cast iron in the early types, wrought iron in later types and a combination of both in even later types). However these variations could be due to changing economic circumstances of the owners. An analysis was made of the historic events in Portugal between 1760 and 1830 (see Appendix 4.2) which would have produced serious economic upsets, and could have affected the owners' circumstances, obliging them to cut down on the expense of the final stages. Also the finishings could have changed due to fashion as in the case of opting for wooden or plaster ceilings or the absence or profusion of tiles.

Not all differences in detail are associated with the different types. The details for which it is possible to establish a link with the proposed types are:

i)The "solid" balustrade wall

Between types 1 and 6 the balustrade wall shows a continuous change of form from a continuous "solid" wall to a zig zag pattern, "solid" balustrade. In type 7 although the overall form of the balustrade wall is similar to the previous types, the construction is different. In types 1 to 6 the balustrade has a timber frame structure similar to that of the *cage*, (see Fig.300), but in type 7 they were made with planks similar to the "costaneiras" walls.

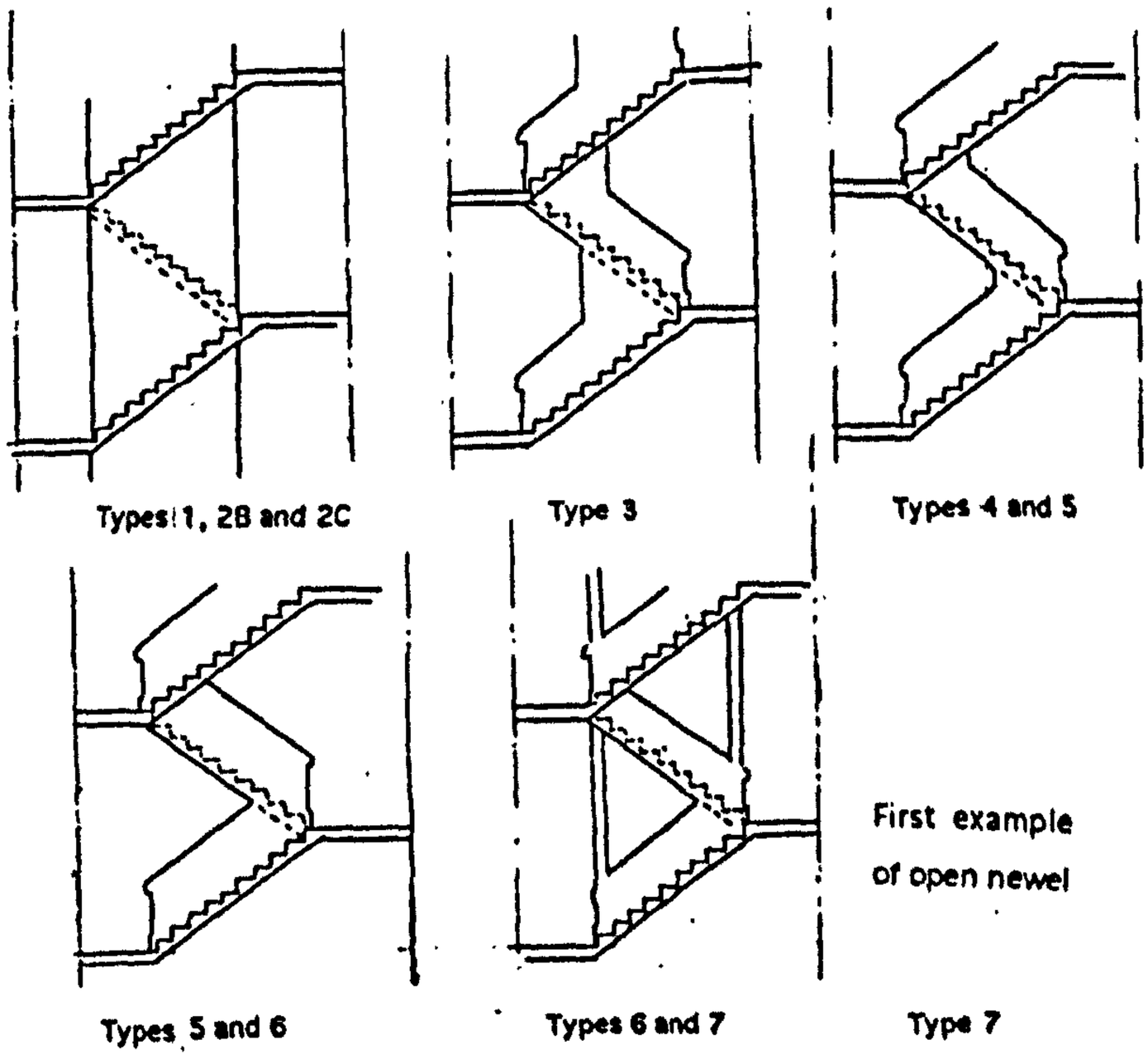


Fig.300-Variations in the balustrade wall

ii)Handrails

In types 1 to 3 there is a mopstick handrail fixed to the side wall. In types 3 to 7, the top of the wall balustrade is covered with three simple boards which in type 5 are carved to act as a handrail. After type 6 a more complex moulded handrail was used along the tops of the balustrade, (see Fig.301)

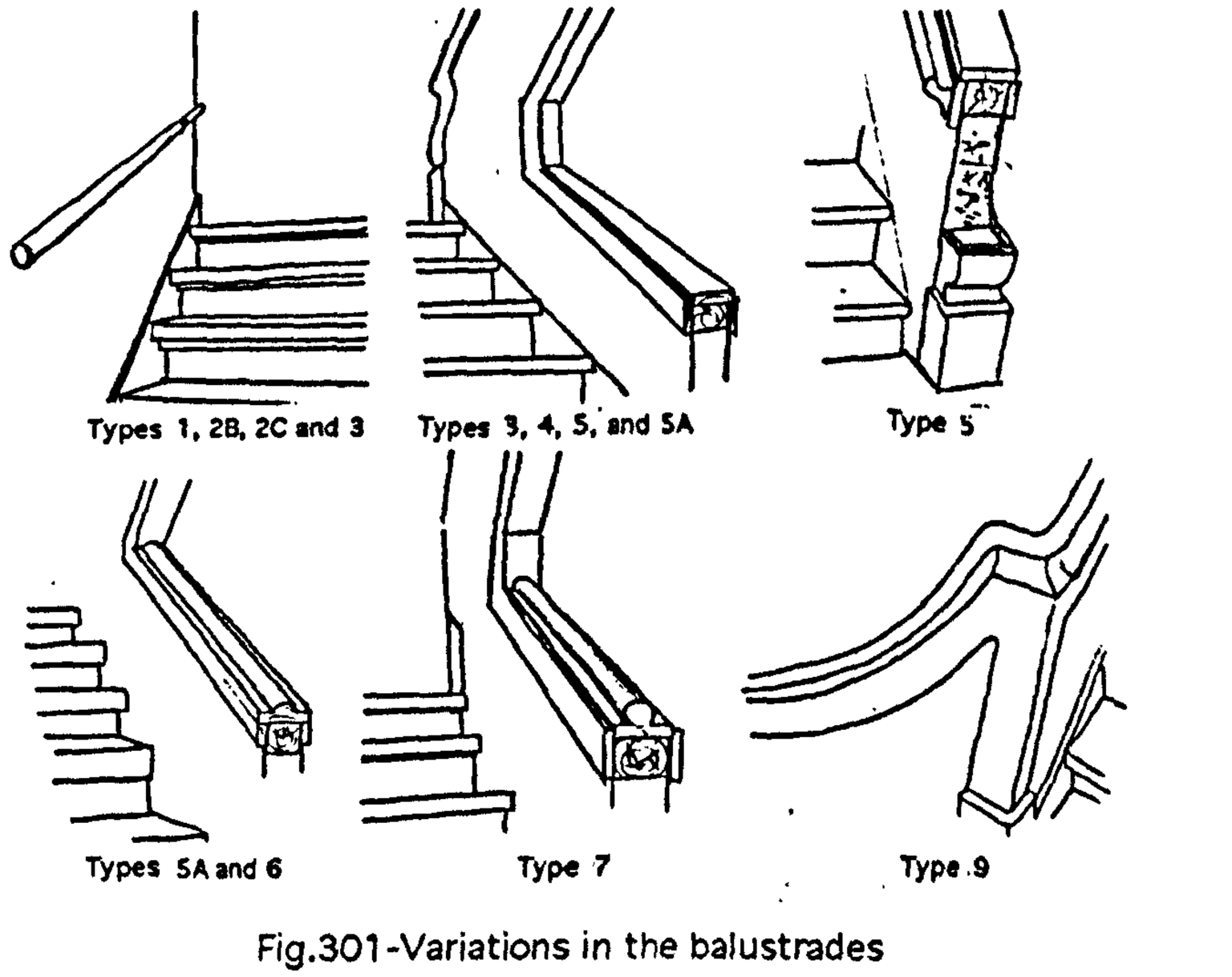


Fig.301-Variations in the balustrades

iii)Steps

Different types of steps on the stairs are also linked to the different types. In types 2A, 2B, 2C, 3 and 4 the steps were made with simple boards. In types 5 and 6 a shaped riser supports the tread. In types 8A and 9 the moulded riser was substituted by a simple strip of wood. In type 11 the tread has additional nosing which could be replaced (Figure 302).

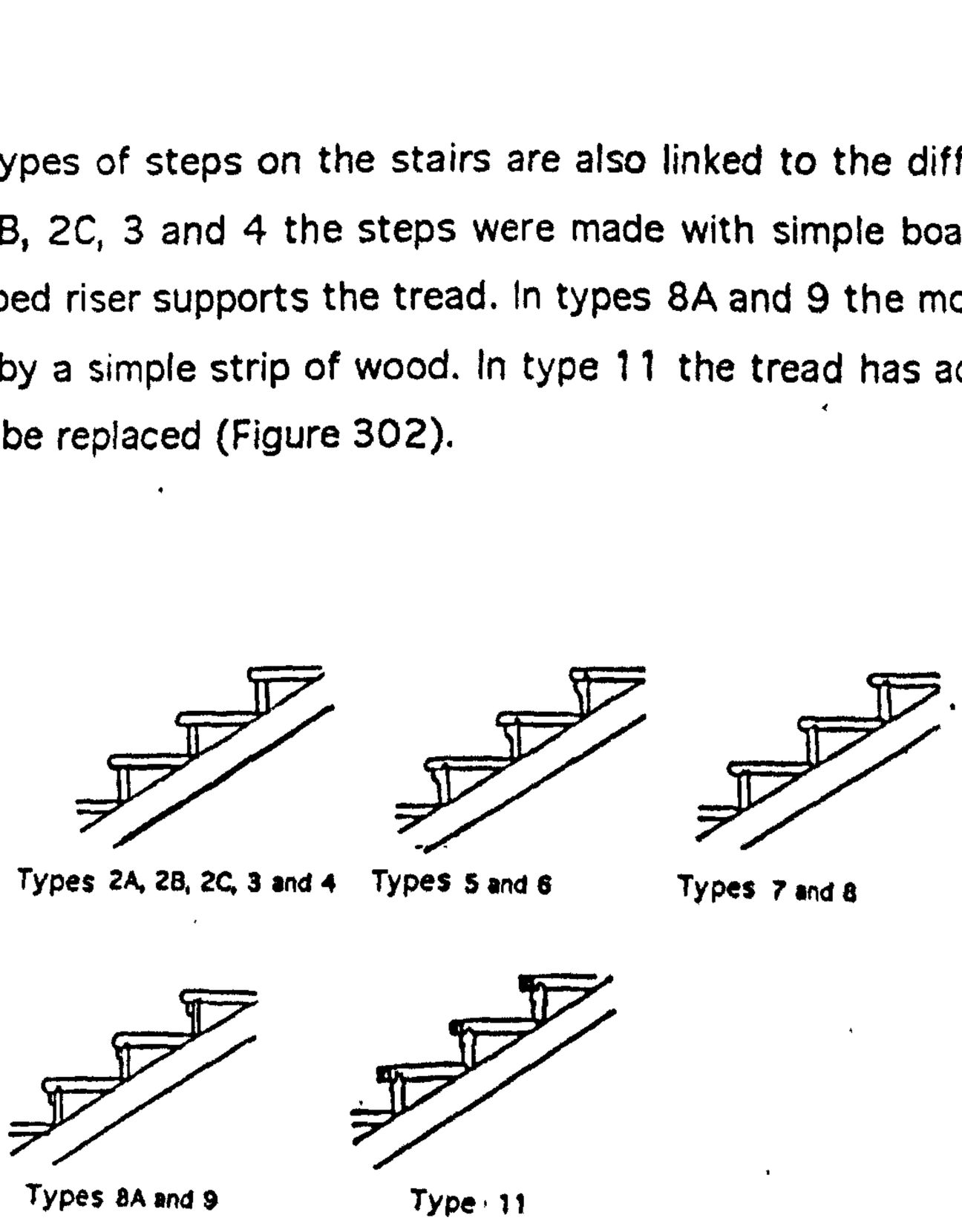


Fig.302-Variations in the steps

iv)Doors

Over the years doors and windows have been changed. For example the original windows in the Pombaline Area were similar to those shown in Figure 110, with small panes, which today are rare. In types one and two the entrance doors seemed not to be the original ones because, in the interior of the flats of these types there were found ledge doors which are associated with type 3. In types 5 and 6 the boards are replaced by two panels which in types 6, 7, 8, 9, and 10 are further divided to produce four panels. In types 9, 10, 11 and 12 the panels are more sophisticated and are held in grooves rather than lapped and rebated (Figure 303).

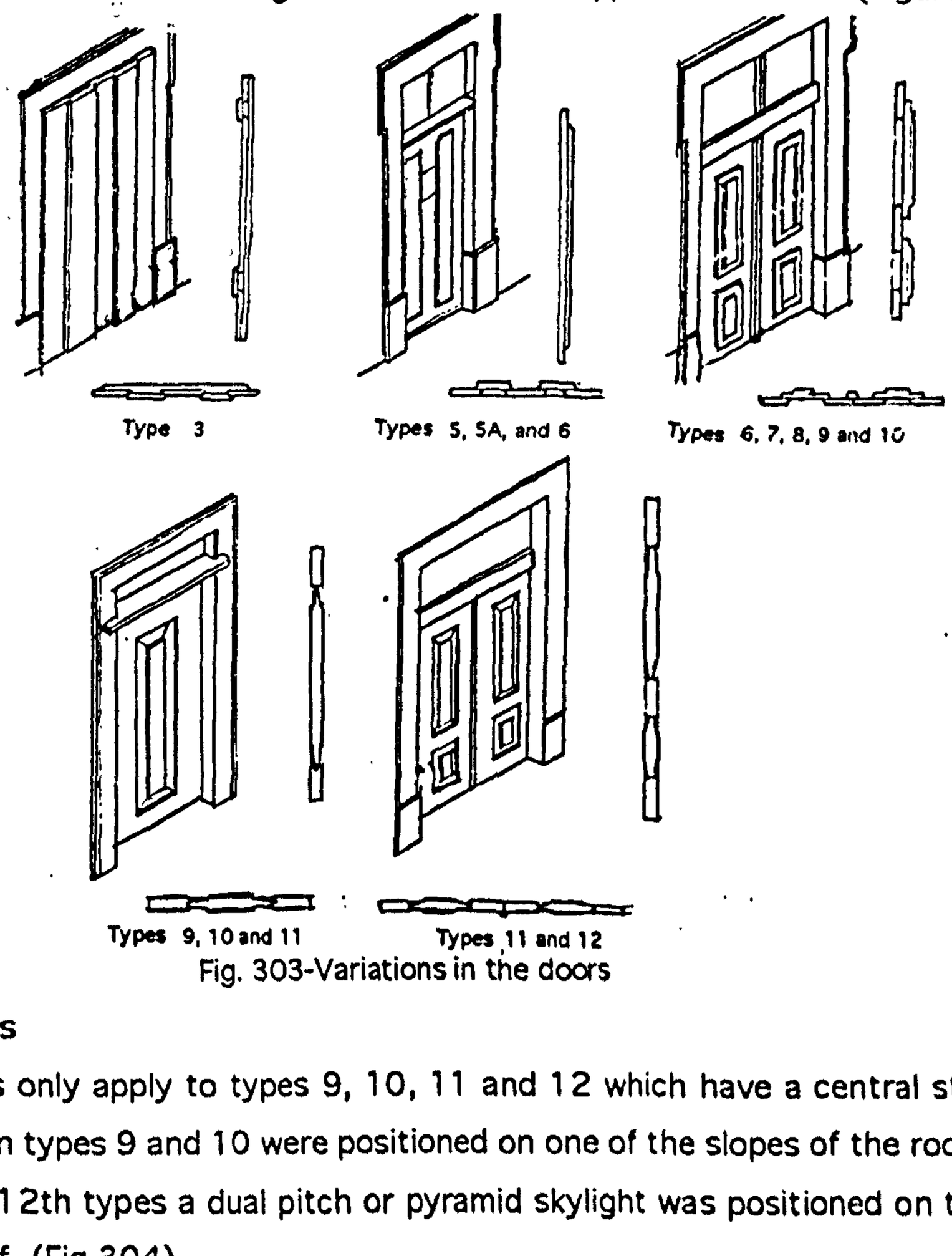


Fig. 303-Variations in the doors

v) Skylights

Skylights only apply to types 9, 10, 11 and 12 which have a central staircase. Skylights in types 9 and 10 were positioned on one of the slopes of the roof. In the 11th and 12th types a dual pitch or pyramid skylight was positioned on the ridge of the roof, (Fig.304).

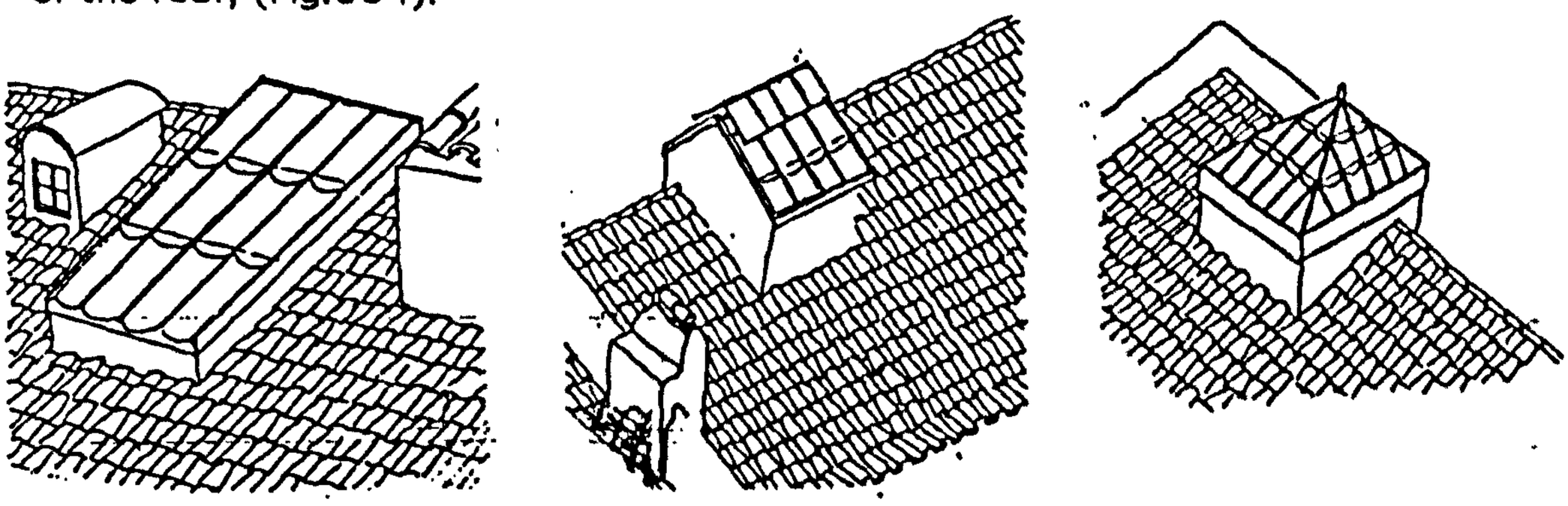


Fig.304-Variations in the skylights

V.4. Evidence for an evolutionary sequence in the internal plan of the buildings.

Section V.2. identified twelve different types of internal plan for the stairways which represent a possible chronological development. The sequence 1-12 tended to go from simple to more complex and also the siting of stairways tended to go from medieval to modern. There is a trend to go from stairs at the front, phase 1 (types 1-3), to stairs at the rear, phase 2 (types 4-8), to stairs in the middle, phase 3 (types 9-12).

Based on the information of the survey reported in Appendix 5 a plan was produced in which the type to which each building belonged was marked on the plan by a particular colour (see Figure 305). Table 5.1 below gives the percentage of these buildings which fall within each of types 1 to 12.

Table 5.1 buildings falling within each type

(In all Pombaline Area)

Types	1	2	3	4	5	6	7	8	9	10	11	12
n. of buildings	1	21	8	21	62	21	16	41	60	15	34	22
% of buildings	0.3	6.6	2.5	6.6	19.7	6.6	5.0	13.0	19.0	4.8	10.8	7.0

Attempts were then made to verify the hypothesis of an evolutionary sequence by attempting to locate historical data that would provide dates either for buildings or streets.

Unfortunately no documents could be traced which related to individual buildings and their dates. The documents in existence in the Archives of the Municipality which relate to each rentable building are records from the beginning of this century. However there is a document, which mentions that in 1766 in the streets of the Pombaline area there existed 59 buildings (31 in Augusta Street) and 140 in 1776[16].

Luís Pastor de Macedo[16] mentioned in his book a period of construction, between 1766 and 1778, but without any reference to the source of this information (see Appendix 4.4). Subsequent work by the author, reported in this section, suggests a more extensive period of construction.

Descriptions by foreign writers about the reconstruction were also studied (see Appendix 4.3).

However in the historical survey conducted by the author useful documents were obtained from another source. The procedure is described in Chapter II and the relevant information acquired is listed in Appendix 4. This information which is in the archives of the Tribunal de Contas is a collection of documents referring to tax collection by parishes "Décima da Cidade de Lisboa e o seu Termo"[47], which give a guide to the number of buildings built each year on the different streets, but without giving the exact location of the buildings. These records refer to payment of taxes by people living

In all Pombaline Area												
Phases	1	2	3	4	5	6	7	8	9	10	11	12
	1	21	8	21	62	21	16	41	60	15	34	22
%	0.3	6.6	2.5	6.6	19.7	6.6	5.0	13.0	19.0	4.8	10.8	7.0

Fig.305-Location of buildings of different types

in buildings and the documents are divided by parishes and the parishes by streets. The numbering of the buildings in the register is arbitrary and does not correspond with the numeration today. Parts of a street can belong to different parishes, the registers are not constant or similar, they do not exist for all years and for some years they are incomplete. Also each parish contains different parts of many streets, corner buildings sometimes belong to one street and sometimes to another. A determining feature is the name of the owner of a building, (although the registers also include payments by servants or people living in single rooms). Therefore considerable interpretation of the information is required. Due to the excessive time needed for a detailed search of all volumes in archaic Portuguese, the analysis was done in approximately ten year intervals (between 1760 and 1830) and was restricted to Parishes of S. Julião and S. Nicolau which include two main streets, Augusta Street and part of Aurea (Ouro) Street, three secondary streets, half Sapateirios Street, half Correeiros Street, half of two transverse Streets, Conceição Street and S. Julião Street (see Fig.306). The data are presented in Appendix 4.1. An analysis of the data for these streets is presented below in Table 5.2:

Table 5.2 Number of buildings on the six selected streets at particular periods

Year	1760	1763	1769	1782	1790	1801	1810	1820	1831
Augusta Street	0	18	42	51	51	51	54	55	55
Aurea Street[a]	7	7	7	7	14	19	19	19	18
Correeiros Street[b]	0	0	0	3	23	22	23	23	23
Sapateiros Street [b]	0	0	3	11	16	15	16	16	16
Conceição Street[b]	0	3	6	10	11	12	11	11	11
S. Julião Street[b]	4	4	9	11	14	17	15	17	17

(a)just a part of street (b) half street

In 1900 (when the streets had been completely rebuilt), Augusta Street had 58 buildings, Aurea Street had 43 buildings, half Correeiros Street had 24 buildings, half Sapateiros Street had 19 buildings, half Conceição Street had 13 buildings and half S. Julião Street had 17 buildings. These are therefore considered as the final numbers of buildings for those streets.

Table 5.3 expresses the number of buildings completed at each period as a percentage of these final numbers.

By 1790 (Table 5.3) approximately 85% of the final number of buildings had been constructed on all streets. Therefore the major differences occurred during the period up to 1790.

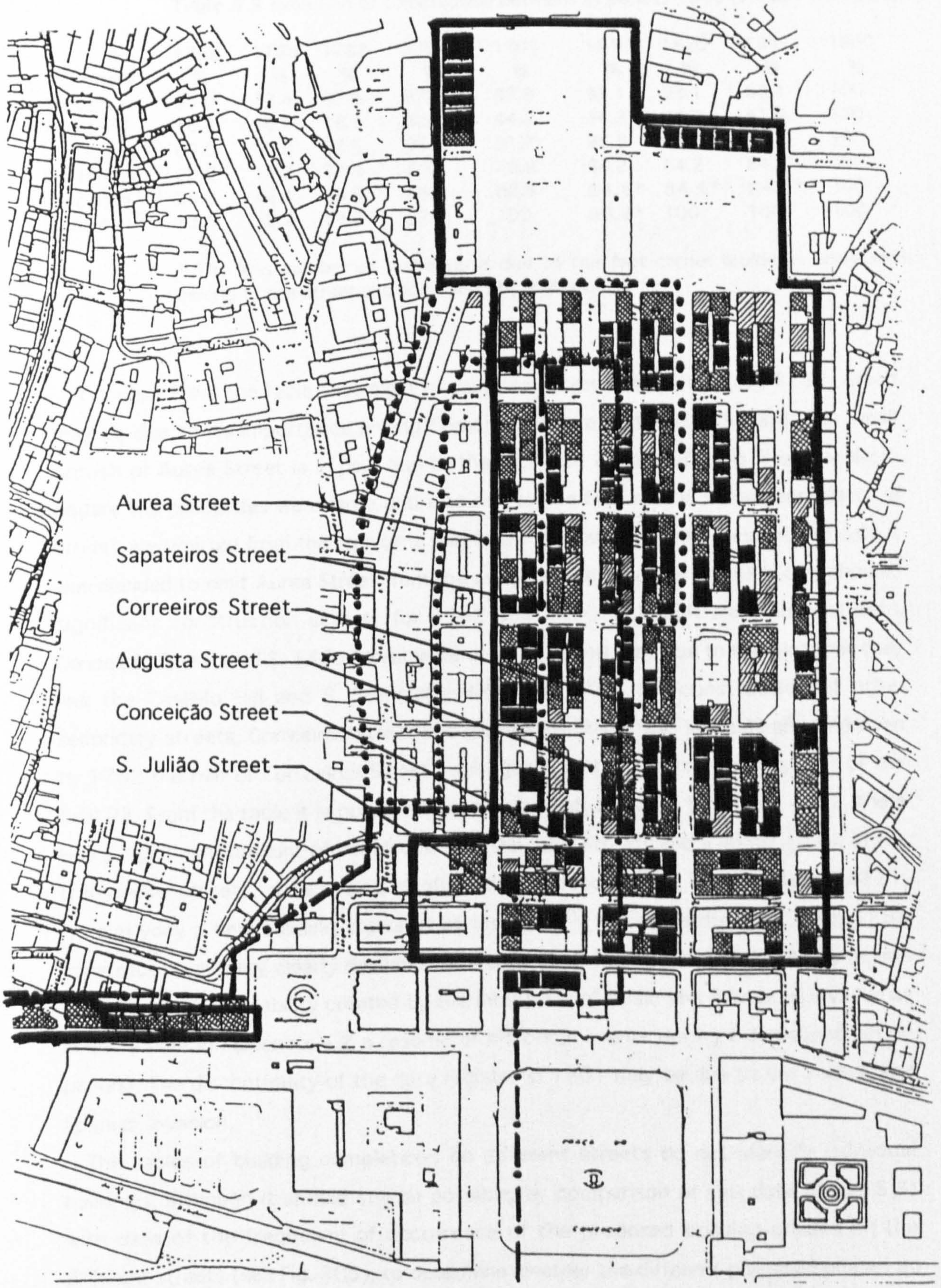


Fig.306-Location of buildings of different phases

Table 5.3 Evolution of construction between 1763 and 1900 (in each ten years)

Years	1763	1769	1782	1790	1801	1810	1820	1831	1900
Streets	%	%	%	%	%	%	%	%	%
Augusta	31.0	72.4	87.9	87.9	87.9	93.1	93.1	93.1	100
Aurea [a]	16.3	16.3	16.3	32.6	44.2	44.2	44.2	41.9	100
Correeiros [b]	00.0	00.0	12.5	95.8	91.7	95.8	95.8	95.8	100
Sapateiros [b]	00.0	15.7	57.9	84.2	78.9	84.2	84.2	84.2	100
Conceição [b]	23.0	46.1	76.9	84.6	92.3	84.6*	84.6*	84.6*	100
S. Julião [b]	23.5	52.9	64.7	82.3	100	88.2*	100	100	100

* The less number of buildings is due to the fact corner buildings sometimes belong to one street and sometimes to another.

It is clear from the table that most of Augusta Street was built before 1782, which may be due to its importance linking Comércio Square and Rossio Square. The small growth of Aurea Street is in part due to the fact that on the left side from Comércio Square the properties were large and also due to the fact that in some years parts of streets are omitted from the registers. Due to the obvious incompleteness of this data it was decided to omit Aurea Street from the analysis. The secondary streets only showed significant construction activity for 1782 and after. Although transverse streets, Conceição Street and S. Julião Street were of some importance due to the fact that they link the Castelo Hill and S. Francisco Hill. Until 1769 the construction of other secondary streets, Correeiros Street and Sapateiros Street was insignificant, and even by 1782 the half of Correeiros Street investigated had only three buildings out of the final 23. From the table it is possible to conclude that, between 1760 and 1782, there was a significant amount of construction in the main streets and a lesser extent in the transverse streets, a fact also confirmed by descriptions of travellers in1771, "....everyday a new building starts to be built..."[20](see Appendix 4.3). After 1782 construction activity clearly declined. This coincided with the end of Pombal's regime (1778) and the instability created by the intentions of Spain and France to invade the country (see in Appendix 4.2 a resume of historical events during the reconstruction period). The discontinuity of the data register in 1801 may be due to the French and Spanish invasion.

The tables of building completions on different streets do not identify individual buildings, although it should still be possible, by comparison of this data (Table 5.3) with data of the frequency of occurrence of the proposed building phases on the different streets (see Fig. 305), to determine whether the different proposed phases do indeed represent an evolutionary sequence.

The three proposed principal phases are phase 1 with stairs at front (which includes types 1 to 3) phase 2 with stairs at the rear (which includes types 4 to 8) and phase 3 with stairs in the middle and corridors consolidated (which includes types 9 to 12).

The distribution of buildings belonging to the different types and phases is represented in Figures 305 and 306 respectively. The numerical distributions of the different types within streets are presented in Table 5.4 below.

Aurea Street is not considered for the reasons given previously and also due to the fact that most of the left side of this street from Comércio Square was rebuilt at the beginning of this century and in addition part of the street was destroyed by a fire in 1991.

Table 5.4 The distribution of buildings within the three proposed phases

	stairs at front phase 1 n.			stairs at rear phase 2 n.					stairs in middle phase 3 n.				total n. of buildings
Types	1	2	3	4	5	6	7	8	9	10	11	12	
Augusta	0	6	1	6	8	1	5	2	4	3	3	6	45
Correeiros	0	3	3	2	5	0	2	5	11	3	5	3	42
Sapateiros	0	3	1	0	6	0	3	4	5	3	4	4	33
Conceição	0	3	0	1	6	5	1	1	2	0	3	3	25
S. Julião	0	0	0	2	3	1	0	2	0	0	0	1	9
Total		20				71					63		

It is clear (Table 5.3) that most of the buildings in Sapateiros Street and Correeiros Street were built later than the buildings in Augusta Street. One would expect that if the 12 types identified are in a chronological sequence there would be a much greater percentage of buildings belonging to the "earlier" types (phase 1) for Augusta Street and a much greater percentage of buildings belonging to the "late" types (phase 3) for Sapateiros Street and Correeiros Street. When the data are amalgamated as below into three principal categories of, stairs at the front, stairs at or near the rear, and stairs in the middle, there is no strong trend apparent between different streets.

Table 5.5 Distribution of buildings within the position of stairs.

	Stairs at the front %	Stairs at the rear %	Stairs in the middle %	Total %
Augusta Street	15.6	48.8	35.6	100
Correeiros Street	14.3	33.3	52.3	100
Sapateiros Street	12.1	39.4	48.5	100
Conceição street	12.0	56.0	32.0	100
S. Julião Street	00.0	88.9	11.1	100
average	13.6	47.6	38.8	100

However in comparing Augusta Street with the two other streets there is a small but significant change in the balance of buildings with stairs in the middle and stairs at the rear, suggesting a later emphasis on stairs in the middle.

Although there does appear therefore to be a tendency during the later stages of the development to construct interiors of buildings with stairs in the middle there is clearly no distinct chronological demarcation between the three suggested principal phases, which must have been built alongside each other at different times.

Moreover, S. Julião Street does not follow the pattern set by Augusta, Sapateiros and Correeiros Streets. It has a higher proportion of late (1782-1790) buildings than Augusta Street, yet it only has one building with a middle staircase.

There are a number of factors, other than the adoption of specific types at specific periods, which may have produced the wide variation observed in the internal plans.

One is client demand allied to the wide range of different architects or builders involved in the projects. For example older well established architects may have opted for more traditional designs whereas younger less experienced architects may have been more innovative. Second it is also probable that builders linked specific types of stairs to different clients, (see Fig.307) who had different preferences for the interior plan of their accommodation related to their lifestyles, different perceived functions and probably of most importance, the levels of their wealth. This could have influenced their choice of architect, possibly including foreign architects.

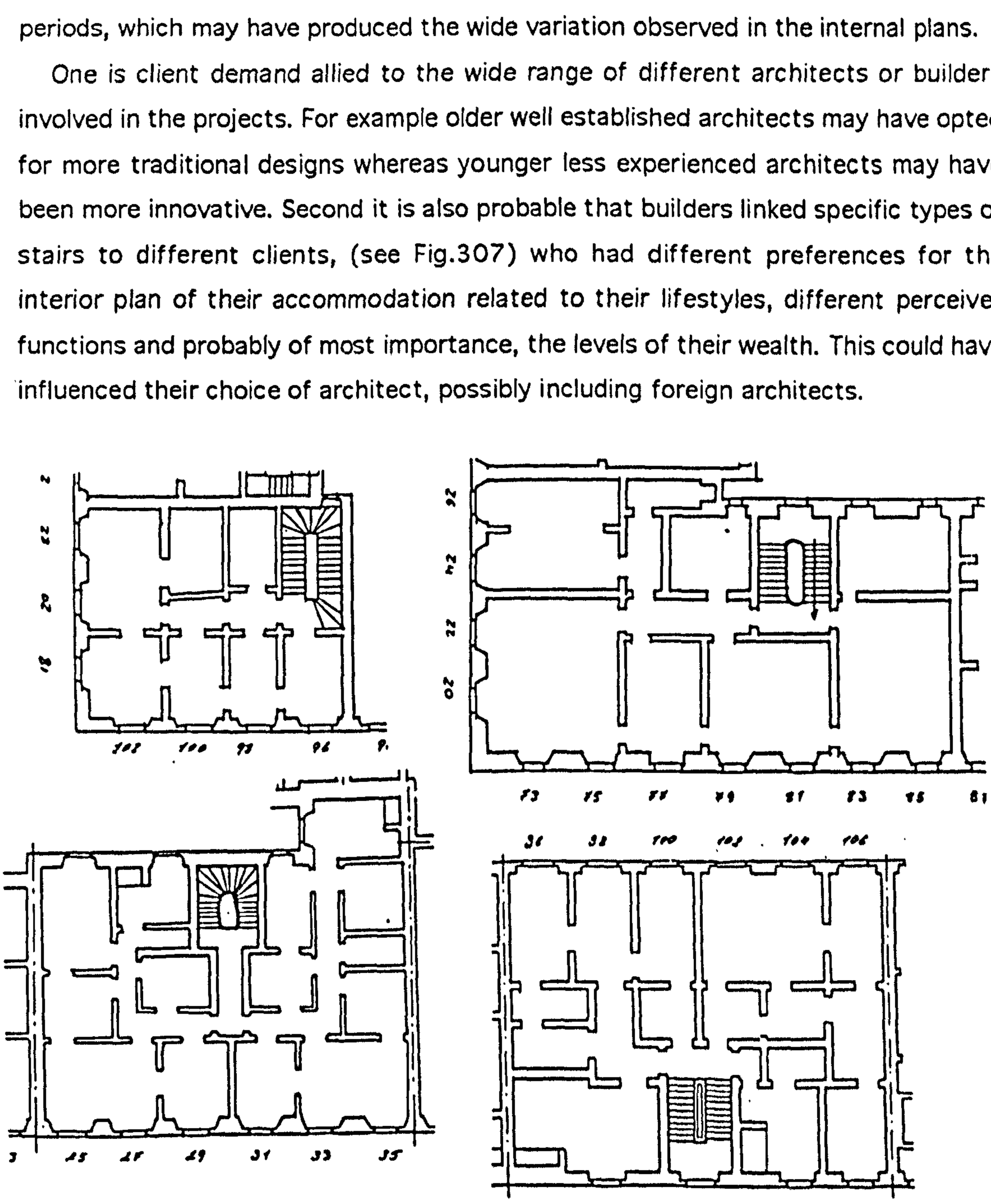


Fig.307-Examples of particular buildings not falling into the three principal categories.

A third possibility is that it was a deliberate decision on Pombal´s part to pander to the requirements of the new merchant class, so that some of the early houses were the residences of important people, built with some of the characteristics of palaces, such as complex stairs, or the absence of corridors. In other cases, people built in order to rent so the stairs are economical and narrow and the houses have corridors for better circulation which is more appropriate for rented rooms. Thus, a range of different internal plans were devised, some more elaborate and expensive than others, to cater for the differences in importance or wealth of different clients. Fourth, in some cases, perhaps due to financial constraints, construction of a building may have taken many years, resulting in a late occupation and a consequent later registration in the Tax Collection record. Financial constraints may also have limited the use of skylights and hence also of central staircases. There are also a few cases (about ten) where it is difficult to identify the particular phase to which the building belongs (see Fig.307). In these cases the form of staircase and the corridor arrangement clearly indicate later building but the position of the stairs could be due to the particular preference of the client.

Whatever the reasons for this diversity they were clearly sufficient to prevent the severe repetition, modulation and standardisation of the façades from dictating the internal plans and restricting variation.

V.5. Summary

The current chapter has described the differences in the internal plans of the Pombaline rentable buildings principally in relation to the design and location of the stairs and the detailing and finishing of the stairways. This enabled the author to classify the stairs into certain distinct types, from type 1 to type 12. The similarity of some of the internal plans with those of medieval buildings and some with those of more modern buildings suggested to the author that the different types of internal plan represented an evolutionary sequence, and these were presented as three separate phases. These phases represent the movement of the stairs from the front of the buildings, in the early phase, to the rear of the buildings, in the intermediate phase, to the middle of the buildings, in the final phase.

From existing records, data were obtained of the number of buildings completed at approximately ten year intervals over the complete period of the rebuilding programme (1760-1831) for five of the streets. Comparing the distribution of

buildings of different types or phases within each street with the numerical growth of the buildings in each street, it was possible to assess whether the suggested phases represent an evolutionary sequence. For example, Augusta Street was mainly completed at a relatively early stage in the rebuilding programme whereas other streets (i.e. Sapateiros Street and Correeiros Street) were completed at a later stage. One would therefore expect a much greater proportion of buildings in Augusta Street to belong to the proposed early types and the reverse to be true for Sapateiros Street and Correeiros Street. Although such a strong relationship was found not to be the case and the distribution of the different types tended to be similar in all streets there were significant trends apparent in the data. In particular the proportion of buildings with stairs in the middle tended to be higher in the streets built later and lower in the streets built earlier. The reasons for this trend are however not clearly apparent. The wide variability in types of internal plan cannot therefore be simply attributed to an evolutionary process and may have resulted from a number of possible influences. These are suggested to be client choice, variation in style and approach by the many architects and builders involved in producing the interiors, economic factors and the Marquis of Pombal pandering to the requirements of the new merchant class. It is suggested that a combination of these influences together with the possibility of a number of other unknown factors, contributed to the final result which can be seen today.

It would be expected that the massive rebuilding programme initiated in the capital city of Portugal after such a devastating earthquake would have repercussions much wider than the confines of the city of Lisbon. Therefore the next chapter will try to determine if the innovations brought about by the Pombaline buildings were exclusive to the Lisbon area, or whether other areas were influenced by these developments. To do this, a number of developments contemporary with or following the Pombaline rebuilding will be examined. These are the nuclei of Vila Real de Santo António, Manique do Intendente and Porto Côvo . A comparison will be made of these developments with that in Lisbon, to determine whether the type of reforms introduced by Pombal in Lisbon influenced these more outlying areas.

CHAPTER VI. THE POMBALINE RENTABLE BUILDING IN PORTUGUESE ARCHITECTURE.

VI.1. Other contemporary Pombaline developments

VI.1.1.Introduction

In the half century preceding the 1755 earthquake, the Portuguese economy was apparently buoyant since important reserves of gold and diamonds had been discovered in Brazil. This unexpected flow of wealth was increased still further as valuable wood, tobacco, sugar and hides were sent over. The court of D. João V in its extravagance was to squander this wealth on costly monumental buildings and displays, and was not in the least concerned about modernising industry and agriculture. With the plentiful supply of gold and diamonds they simply bought manufactured products from abroad, especially from Britain, instead of consolidating the national economy, and the country´s industry and agriculture remained neglected.

Following the death of D. João V, D. José I inherited a deep crisis: the coffers at the treasury were completely empty and gradually all the wealth from Brazil was drained away. The economy was virtually paralysed as it was dependent on the production of manufactured goods from abroad. Without any gold to purchase goods and with uncompetitive national production, commerce was in a serious crisis and this affected the revenue of the state. The conflict in Europe, the "Seven Years War", found the country in a difficult situation not only in economic but also in military terms.

In order to achieve a good balance of payments Pombal, the minister of the Crown, first attempted to reduce imports and to provide incentives for the production of those goods that were necessary to the population. Alongside the attempted economic and industrial reorganisation of the country there was also a military reorganisation.

The imposition of a new economic and administrative order was to be affirmed with the construction of urban developments in certain parts of the country with economic potential, (Fig.308). This increase in the construction of urban developments in Portugal was not an isolated phenomenon. All over Europe planned cities, such as St Petersburg, Bath, Edinburgh and Amsterdam, were being built or reconstructed(46) in some cases as a utopian display. In Spain many cities were built. In Portugal urban centres were built or rebuilt in order to implement Pombal´s reforms, and were all to some extent characterized by simplicity and austerity dictated by functional necessity rather than theoretical choice.

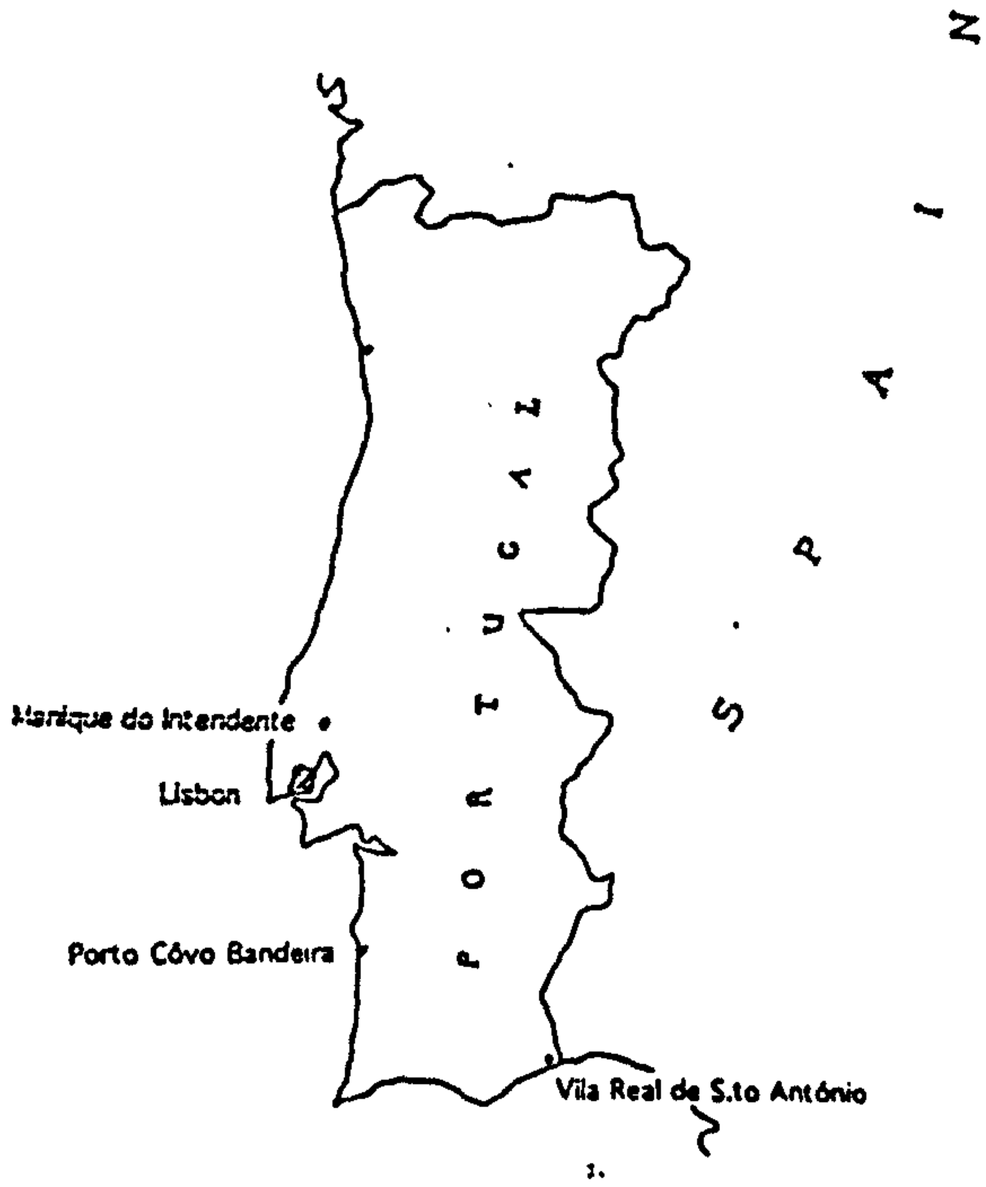


Fig.308-Locations of Pombaline nuclei in Portugal

VI,1.2 . The urban developments

The reconstruction of Lisbon was not an isolated phenomenon although it is better known than other contemporary developments due to the importance of its location, size and the techniques involved given the urgency of the situation and the particular conditions of the unstable land on which it was built.

If the case of Lisbon is more complex, the other developments can not be ignored as they enable an understanding of the amplitude of the Pombaline phenomenon. To understand completely the Pombaline phenomenon in Lisbon, it is necessary to understand the other developments which have in common: the fact that buildings are organized in blocks, where the rentable buildings dominate; construction is standardized, modulated and repetitive; and their character is austere in relation to the contemporary architecture of the time. On the other hand different conditions led to some different characteristics in each development.

Vila Real de Santo António, a completely new planned town, on a flat site free of buildings, designed along very similar lines to colonial cities, was built because of the country´s economic policy in relation to the Algarve (46).

Porto Côvo Bandeira is a development that was financed by a merchant, in order to improve the development of the Alentejo. Its most important feature is the way in which the traditional style of housing in the region was adapted to the Pombaline concepts (59).

Manique do Intendente was built after the fall of the Marquis of Pombal, by an important police superintendent in order to develop a large, fertile agricultural area(60).

VI.1.3. Vila Real de Santo António

The construction of Vila Real de Santo António was undertaken from 1773 onwards as part of the attempt to reorganise the economy of the country through industrial development and tighter tax and customs controls. The Algarve, a region where fish were plentiful, had up until then been practically abandoned (46). The Portuguese treasury annually lost huge sums through tax evasion and smuggling, while the Spanish made huge profits (46). As the difficulties of a period of economic depression grew, the economic potential of the region and its strategic position in relation to Spain began to be regarded in a new light. The need to create an urban centre for the control of port transactions at the end of the Algarve coastline by the Spanish border was recognised and the new town was intended as a display of political power to the neighbouring Spanish city of Ayamonte (Fig.309) (46).

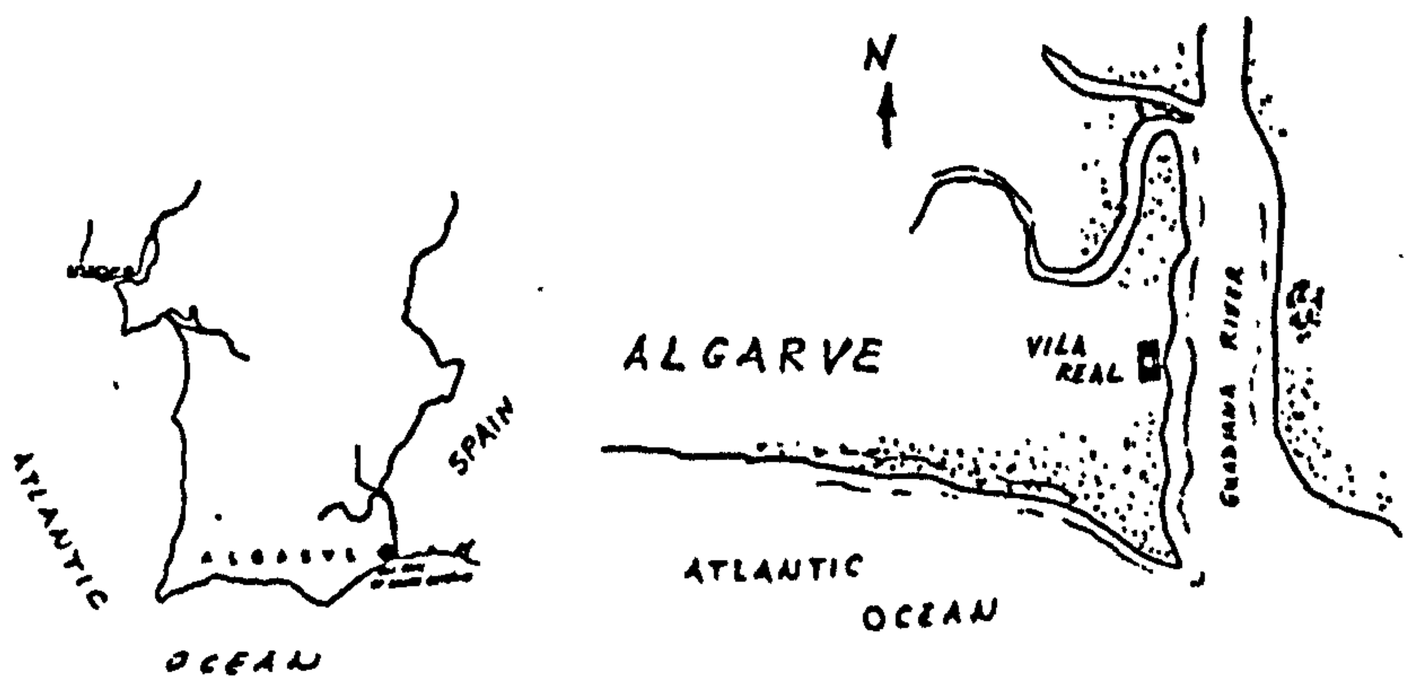


Fig.309-Location of Vila Real de Santo António

Thus on the 17th of December 1773 the first building work on the new city was begun on wetlands by the mouth of the Guadiana River, and as in the Pombaline quarter of Lisbon, military engineers were in charge. Monopolistic and private companies were invited to establish themselves in accordance with the plan drawn up by the architect Reinaldo Manuel, by express order of the Marquis of Pombal, with the same rights and duties as those who had taken part in the rebuilding of Lisbon (61).

The first building to be constructed was the Customs House, followed by the military barracks, public buildings and Company offices. Homes came last, which is why, in order for them to be built faster, fishing villages such as Monte Gordo, were torn down or burnt down, to provide new inhabitants (46). The construction of the new town was finished in 1786.

The plan , as in Lisbon, consisted of a rectangle, with one of the long sides facing the river, to the east. The rectangle was cut by 5 streets in a North-South direction and six orthogonally in an East-West direction. All the streets were the same width and they contained 43 blocks; 32 of which were identical in size, being 240 palms by 100, (Fig.310).

Like the Pombaline area the grid has a North-South orientation, but in contrast to Lisbon the whole area was organised around a large central square close to the river, (Fig:311 and 312), with no separation between the location of rentable buildings and Public buildings.

Fig.310-The darker area represents the original town of Vila Real

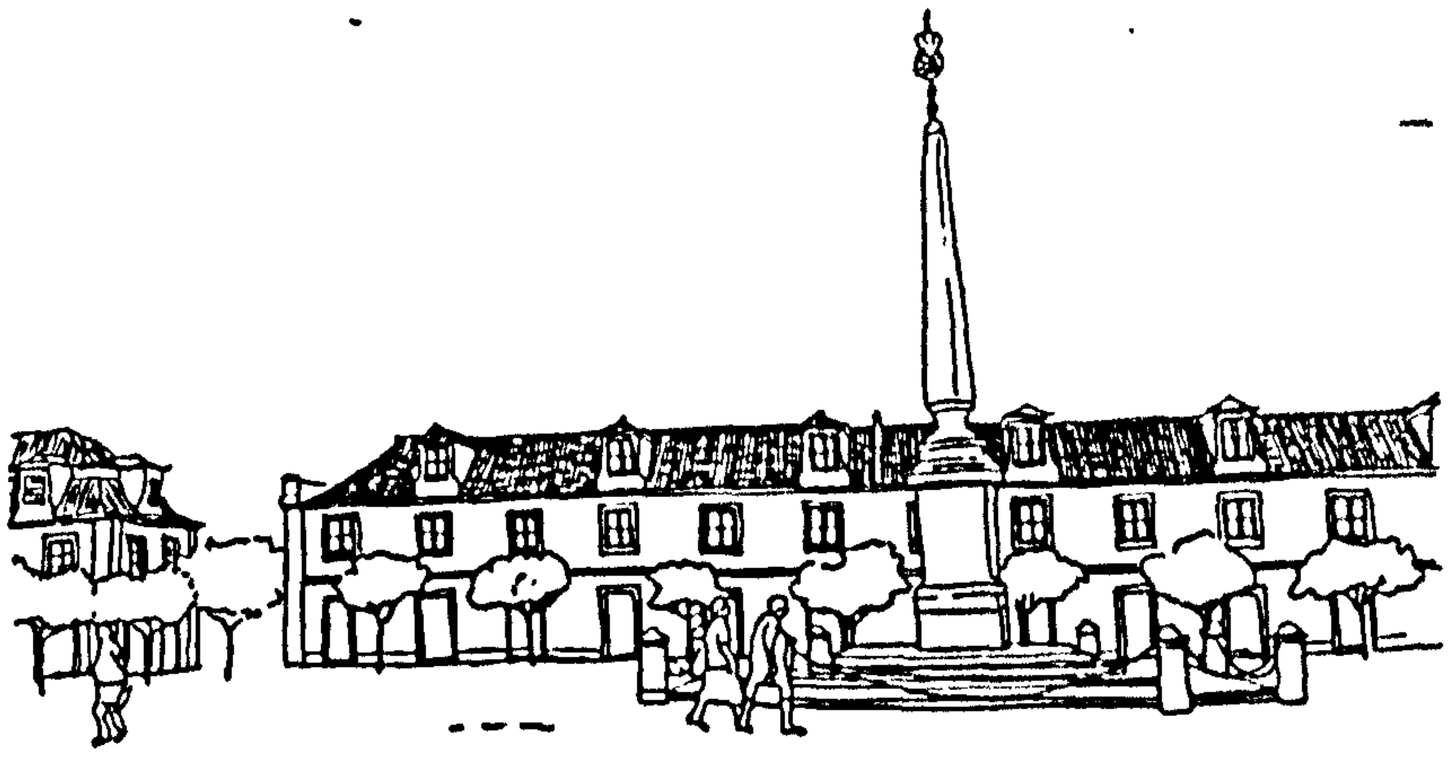


Fig.311-The Central Square

Fig.312-The Central Square

Whereas in the Pombaline quarter of Lisbon the hierarchy of the rentable buildings was reflected only in street widths and architectural details, here the number of storeys was an additional and important distinguishing feature, (Fig.313).

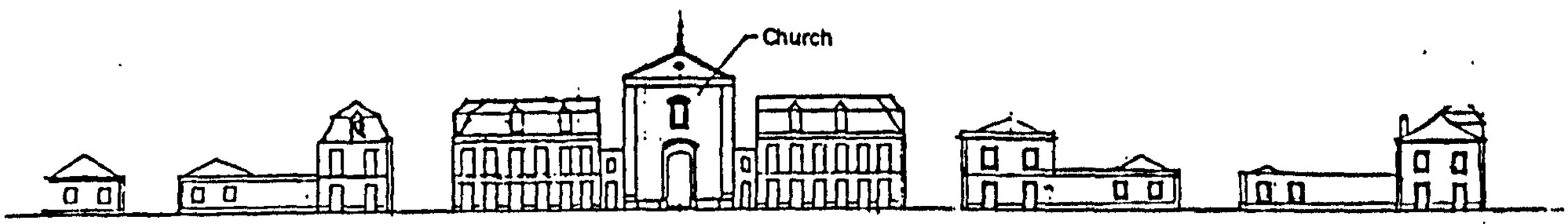


Fig.313-The hierarchy of the buildings

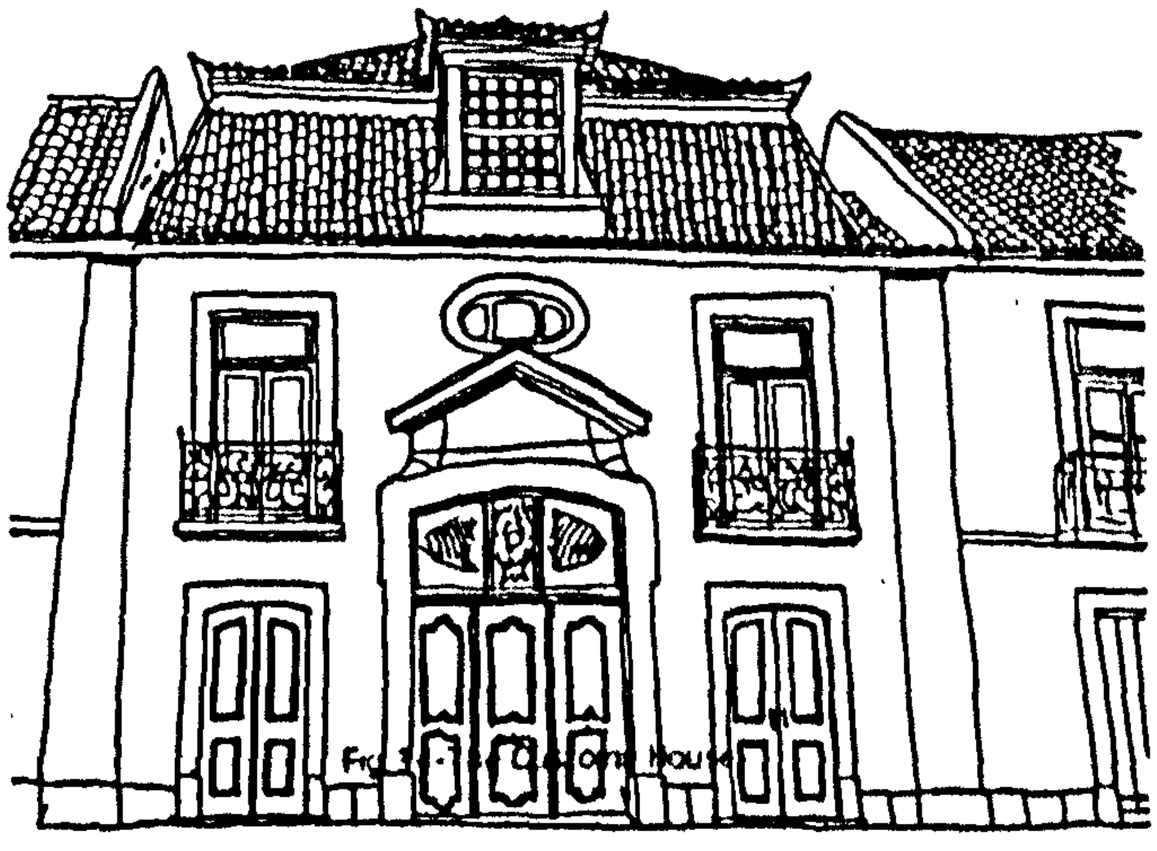
The most important rentable buildings had two levels whereas the less important only had one, and houses of the same type usually had the same area.

In terms of decoration, only the Custom House and the Church had individually designed façades and the volume and proportion of the Custom House were very close to those of the rentable buildings. However, the height, proportions and volume of the Church (Fig.313) are significantly greater than those of the other buildings, and it has a central position in the Square, and in this way the church is given greater emphasis than the few rebuilt churches in the Pombaline quarter in Lisbon.

In Lisbon there had been problems over the redistribution of property, from the old urban plan to the new one, resulting in different frontages; this problem, however did not arise in Vila Real. Only the two storey buidings have the corners of the blocks decorated with stonework pilasters, as all the blocks do in Lisbon.

The most important buildings, the Customs House and the buildings at the ends of the riverfront avenue and the corners of the square, had balcony windows on the first floor and mansard roofs very similar to those of Arsenal Street and Rossio Square in Lisbon, (Fig.314), but there is more extravagant ornament in the Custom House, and the combinations of mansard and dual pitched roofs and single storey and two-storey buildings give the whole town a more varied and less austere character than the Pombaline quarter of Lisbon.

Fig.314-The Customs House



After the Customs house and the corner buildings in the hierarchy came the Company buildings (situated on the seafront) which are also distinguished by first floor balcony windows. Later on the buildings in the square were built, with two floors only. The remaining buildings, as they were less important, had only one level, (Fig.315).

Fig.315-The Society buildings

At the rear of the blocks along the river front were single storey salting houses, and the next blocks back from the river front were occupied by warehouses which were a combination of single and two storey buildings, and were used for storing salted fish, (Fig.316). Apart from the two-storey buildings in the square with mansard roofs, the remainder of the town was occupied by single storey houses.

Fig.316-The single storey houses

The central square formed an important focus of the plan. The buildings here have two floors, and as usual the first floors were occupied by flats and the ground level was used for commerce. On the north side of the square was the Church, on the south side the Guardsmens´ Quarters and on the east side was the prison.

VI.1.3.1. Architectural typology

As in the Pombaline quarter of Lisbon, there is a hierarchy of types of streets and squares rather than blocks. In Lisbon, different levels in the hierarchy are distinguished only by architectural details such as window types and surrounds; in Vila Real, however, there are four quite distinct architectural types: the river front buildings, the buildings in the square, the single storey houses with towers and the single storey houses without towers.

The river front buildings: Twelve company buildings are grouped in six blocks of two buildings each. They have two main storeys, and a third lit by dormer windows. First floor French doors opened onto stone balconies with iron balustrades, connected by a stone string course, and there are mansard roofs at the ends of the blocks, (Fig.317 and 318). The iron balustrades are more ornamented than in Lisbon with a non modular composition but they are repetitive and symmetrical, as in some later Pombaline buildings in Lisbon.

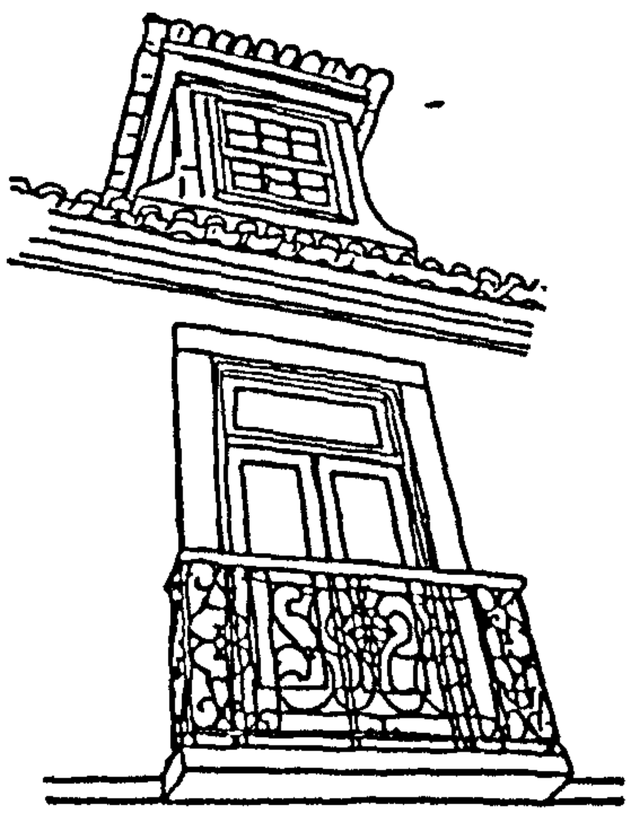


Fig.317-Detail of the façades

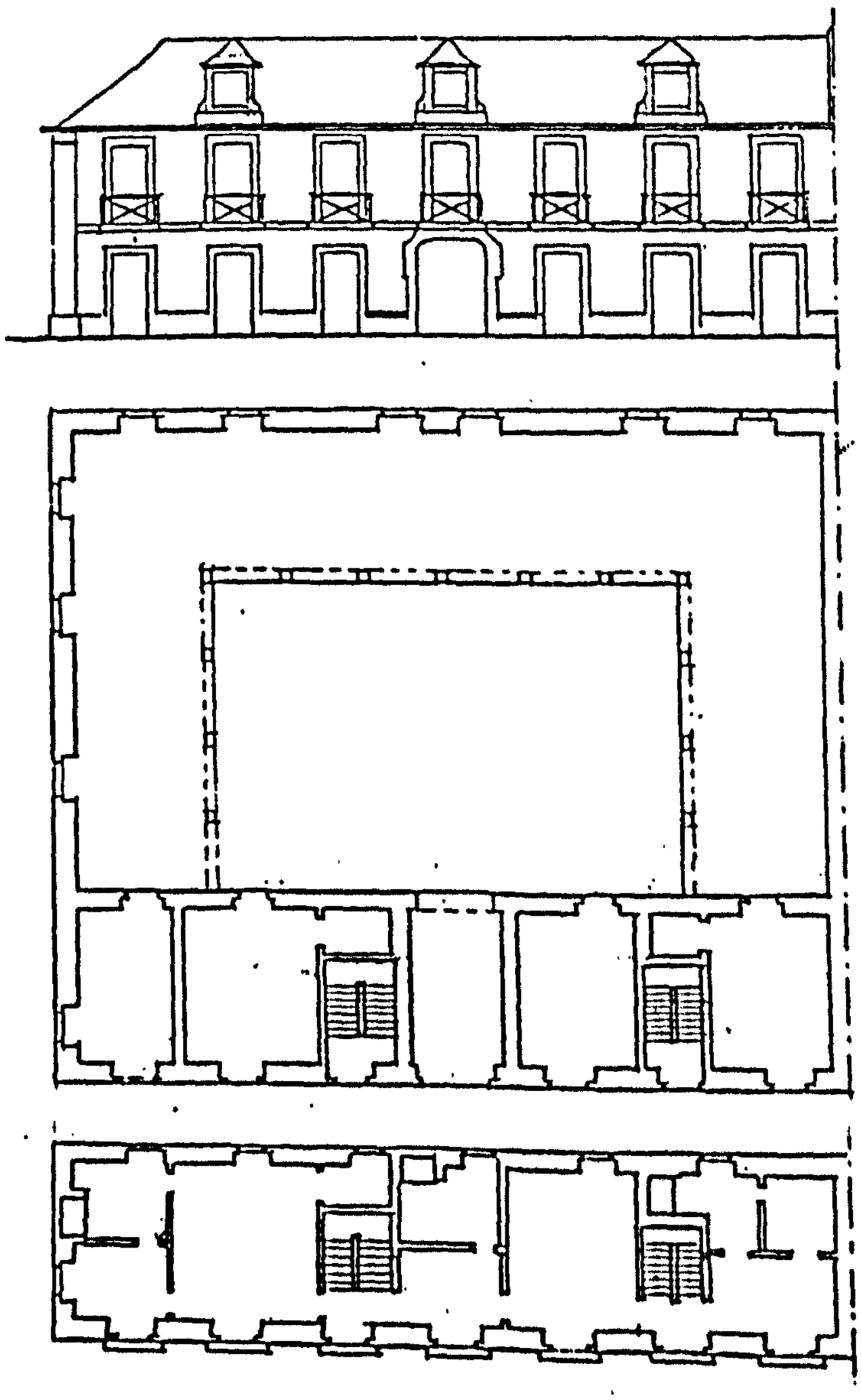


Fig.318-Sea front houses, elevation and plans.

As in some of the buildings in the Pombaline quarter of Lisbon, here there is a stairway in the centre of each building serving the two flats on the first floor. Hence the main entrance is always located in the middle of the property, and is emphasised by a decorative dressed stone surround.

The interior of the houses was very simple with all the rooms interconnecting and no corridor, but unlike in the Pombaline quarter, here the rooms were well-lit and airy as the larger ones had windows on opposite sides and a spacious rear courtyard.

The one room deep river front flats contrast with the two room deep flats in the square and the three room deep ones in the Pombaline quarter of Lisbon.

In terms of construction the ground floor had thick stone walls, and some rooms were vaulted, (Fig.319). As in Lisbon the stairs had two flights, the first being in stone for safety reasons. The walls of the residential floor had an anti-seismic wooden structure incorporated into them, similar to that seen in the Pombaline quarter in Lisbon.

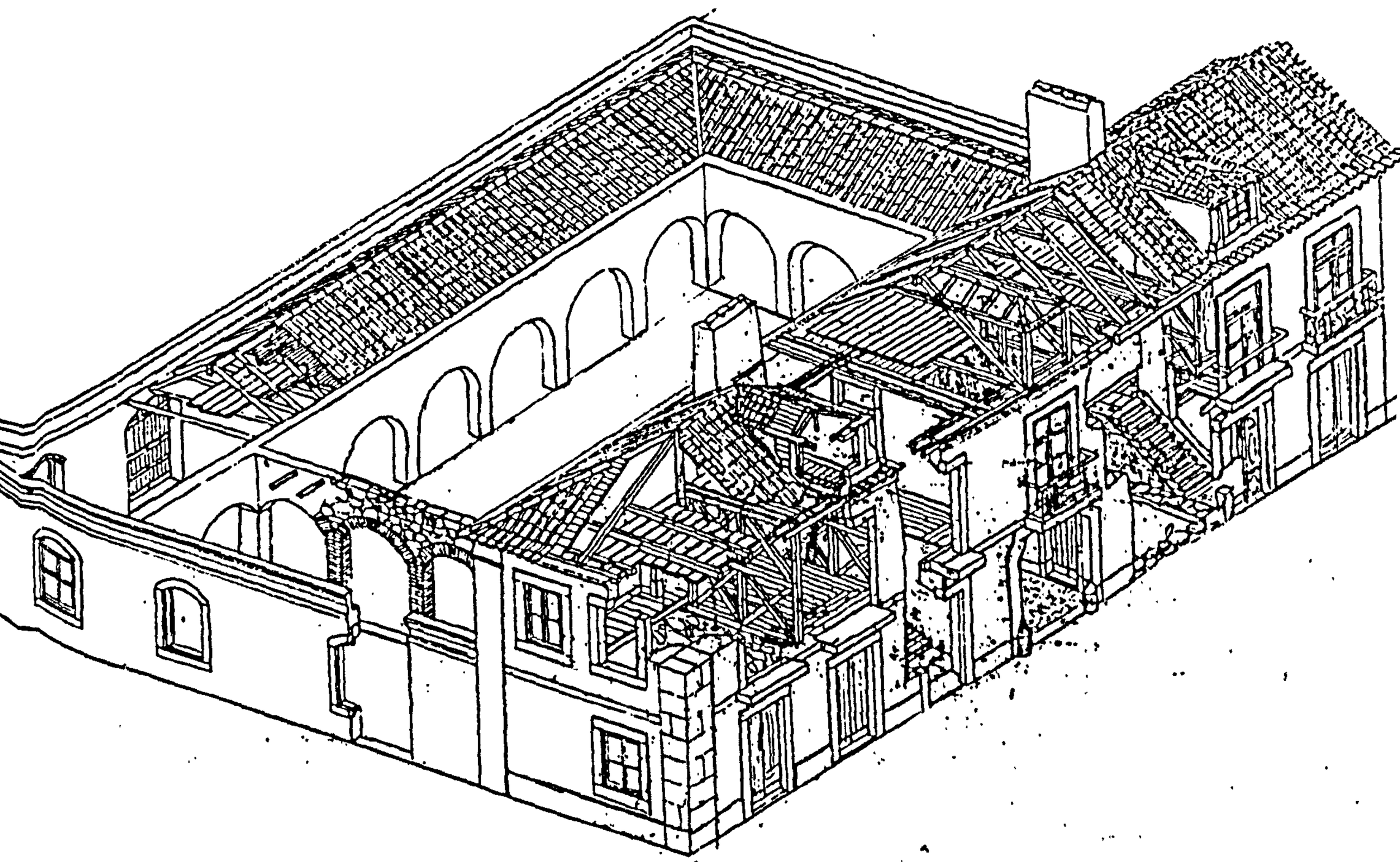


Fig.319-Isometric showing construction of a sea front house, Company building

Finishes were very similar to those in Lisbon, with façade stonework, steps, skirting boards, ceilings, windows and doors being identical, (Fig.320 and 321), with the exception of the main entrance door which is more Baroque than in Lisbon. The elevational treatments of each block were those appropriate to their respective streets as in Lisbon.

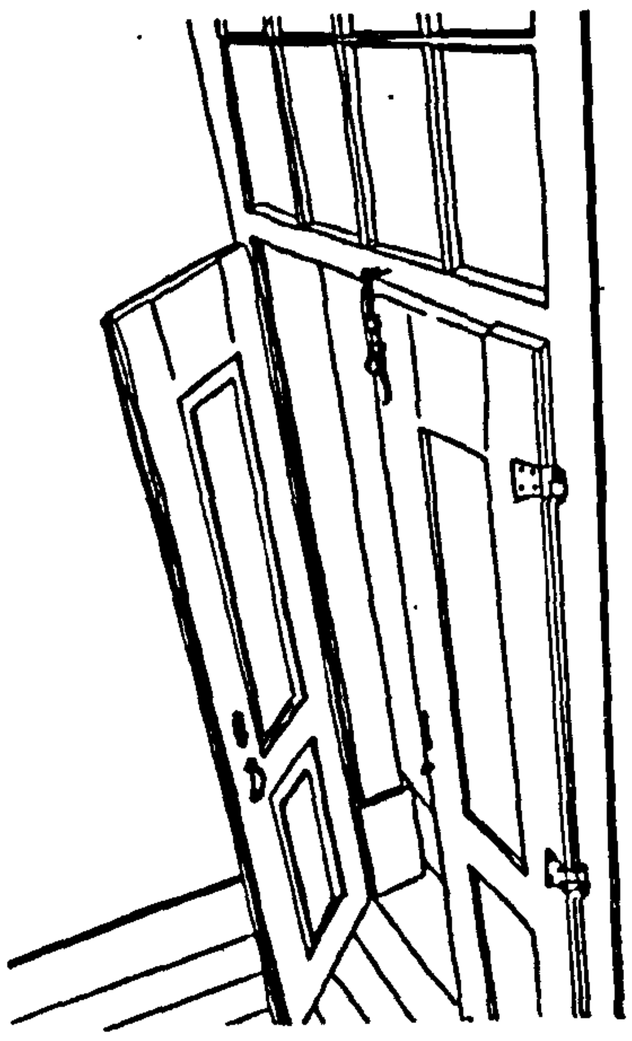


Fig.320-Door of flat

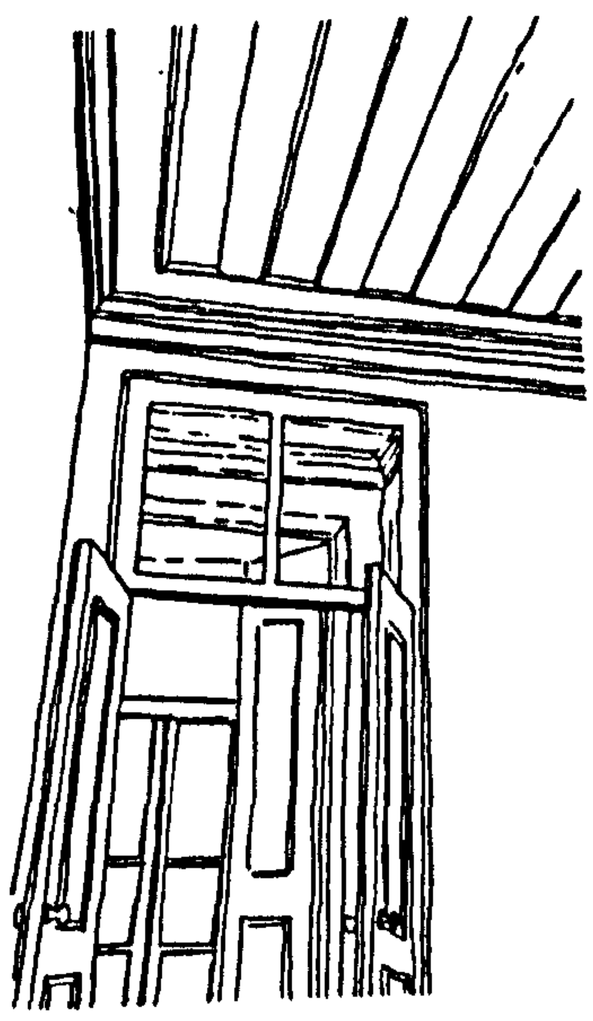


Fig.321-Interior door

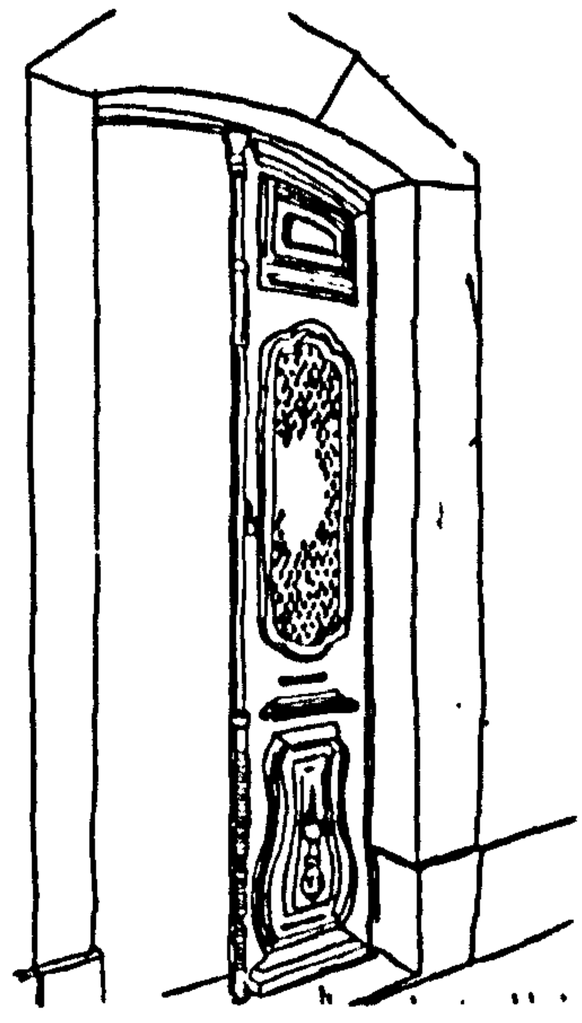


Fig.322-Main entrance door

The roof structure was very simple and repetitive, covered by wooden boards on which the tiles were laid, (Fig.323, 324 and 325).

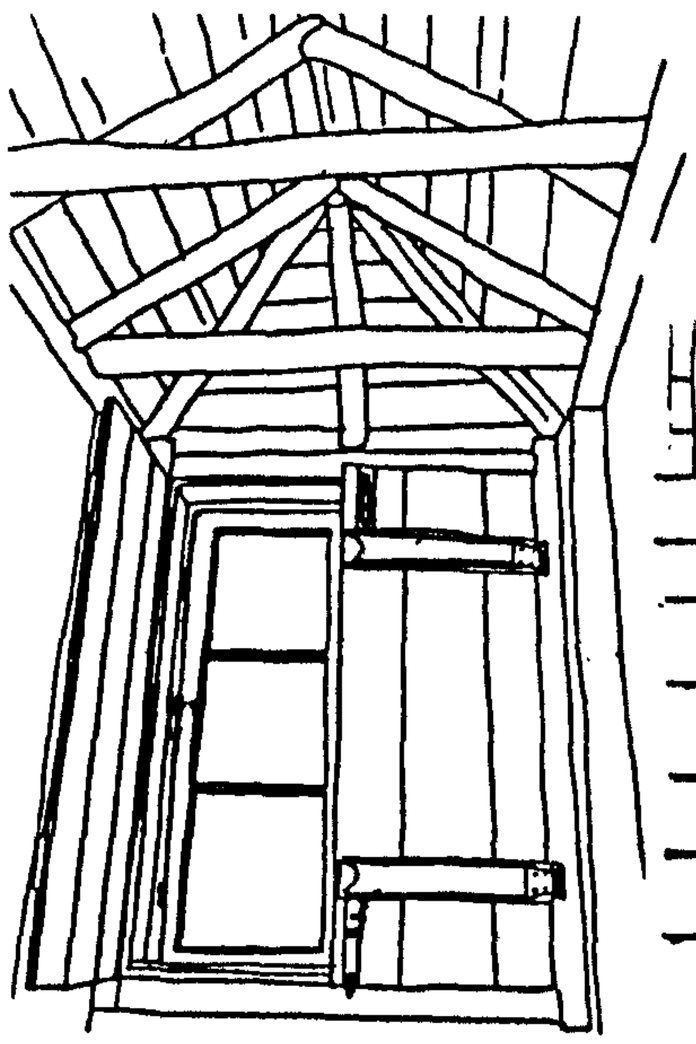


Fig.323-Dormer window from inside

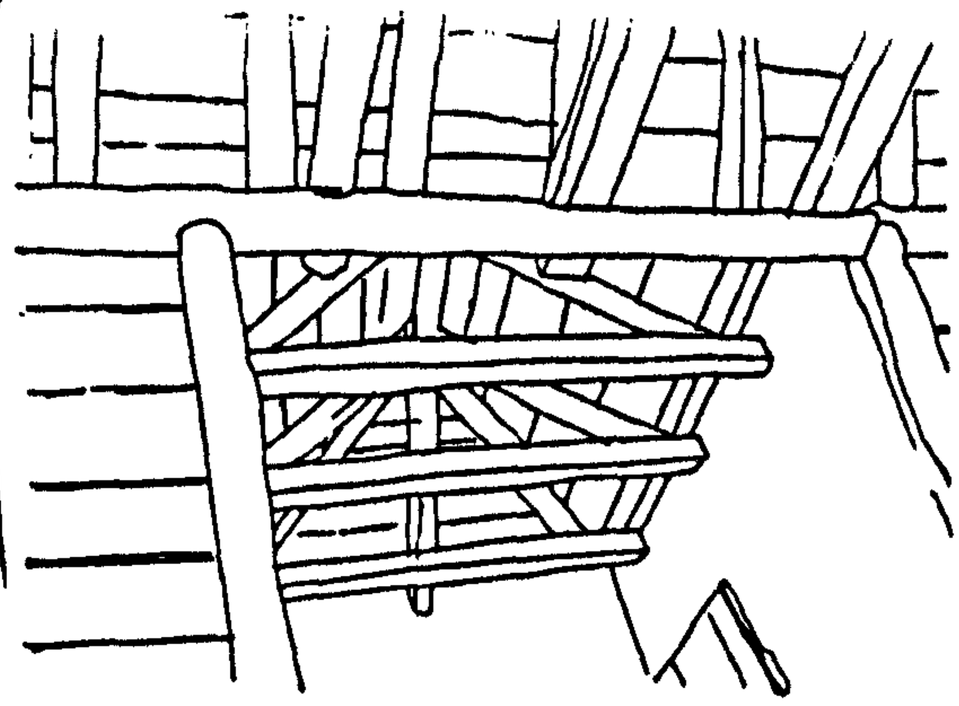


Fig.324-Roof structure

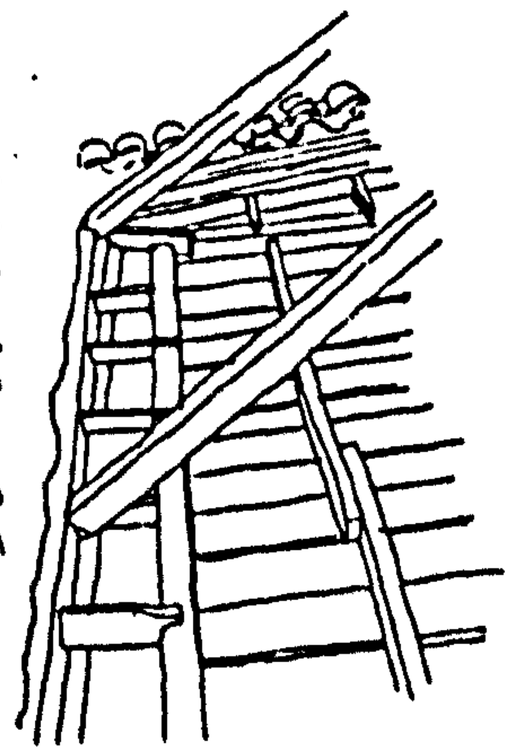


Fig.325-Ceiling structure

The houses at the ends of the blocks of river front houses have mansard roofs , similar to the Rossio buildings in Lisbon; but they are square in plan, were referred to as towers (Fig.326), and create more variety than is found in the Pombaline quarter.

The river front houses have a rear courtyard with arcaded salting houses on three sides, (Fig.327), another feature not found in the Pombaline quarter.

Fig.326-Tower Building

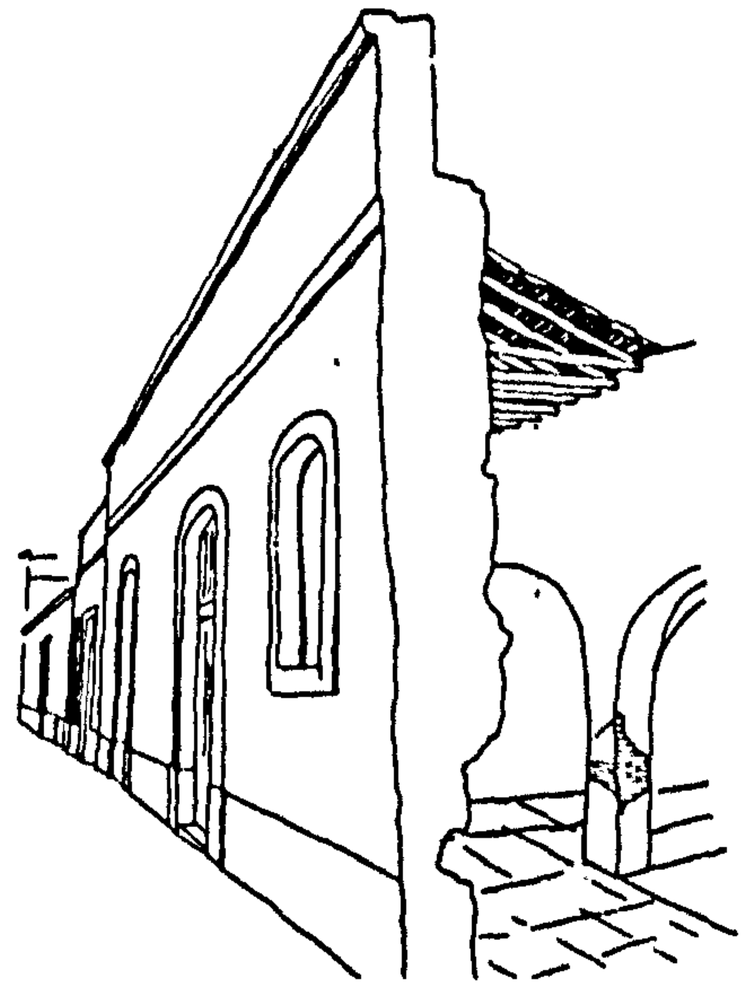


Fig.327-Salting House

The buildings in the square: The openings in the front elevations are perfectly aligned both vertically and horizontally, and are five palms wide, (Fig.328).

In each building the upper residential level had two flats both served by the same stairway. Each flat was two rooms deep with the front rooms facing the street and the rear rooms facing the garden. There was no internal circulation space: the rooms were interconnecting. As in Lisbon these buildings have repetitive elevations with the internal layout varying from one building to another. As all buildings of the square were built simultaneously, the interior layout must have been defined by the occupants´ needs.

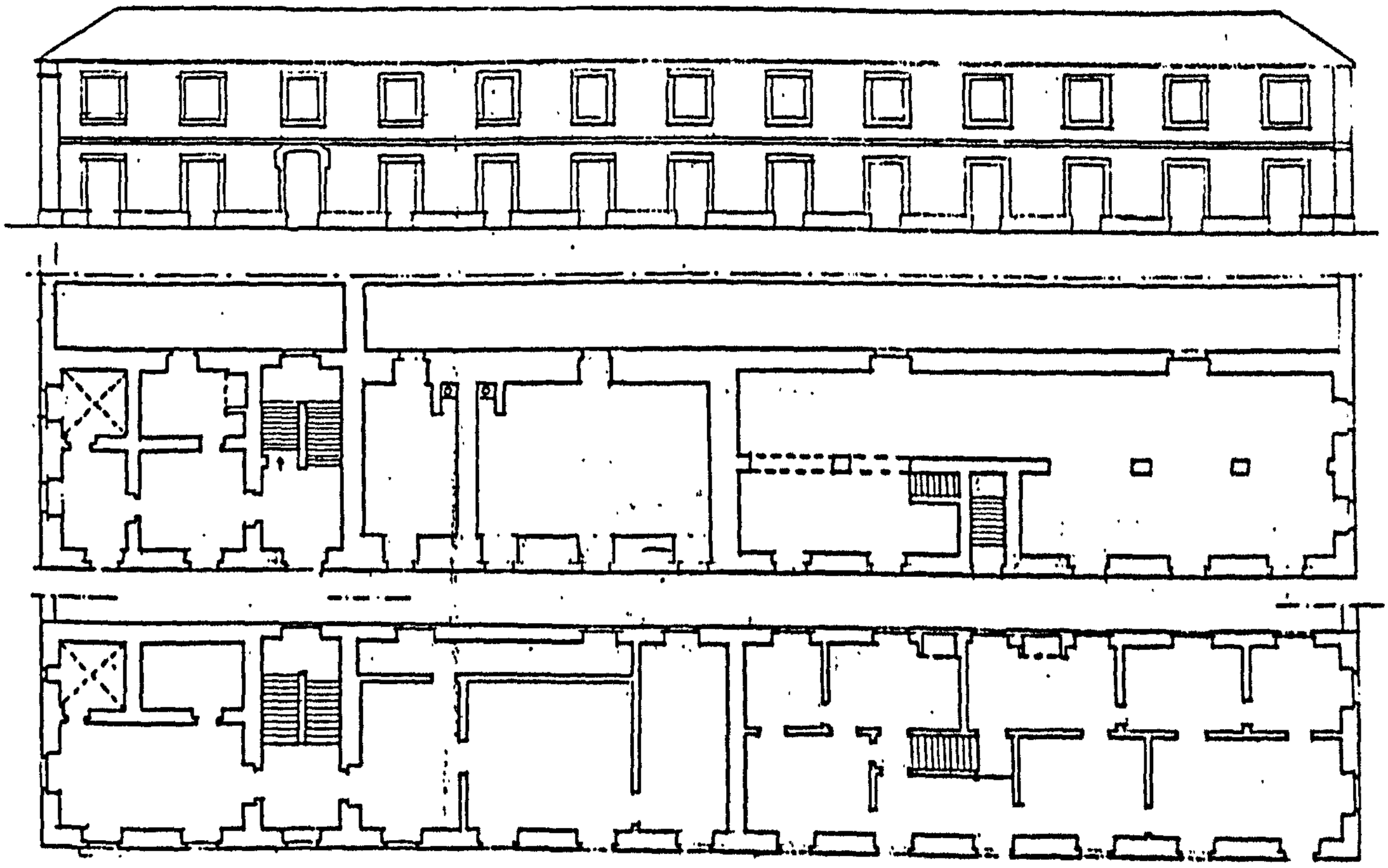


Fig.328-Houses of the square, elevation and plans

Typical corner house in the square: The buildings at the corners with mansard roofs, had shorter frontages and each building had two first floor rooms and a third room in the mansard roof, (Fig.329).

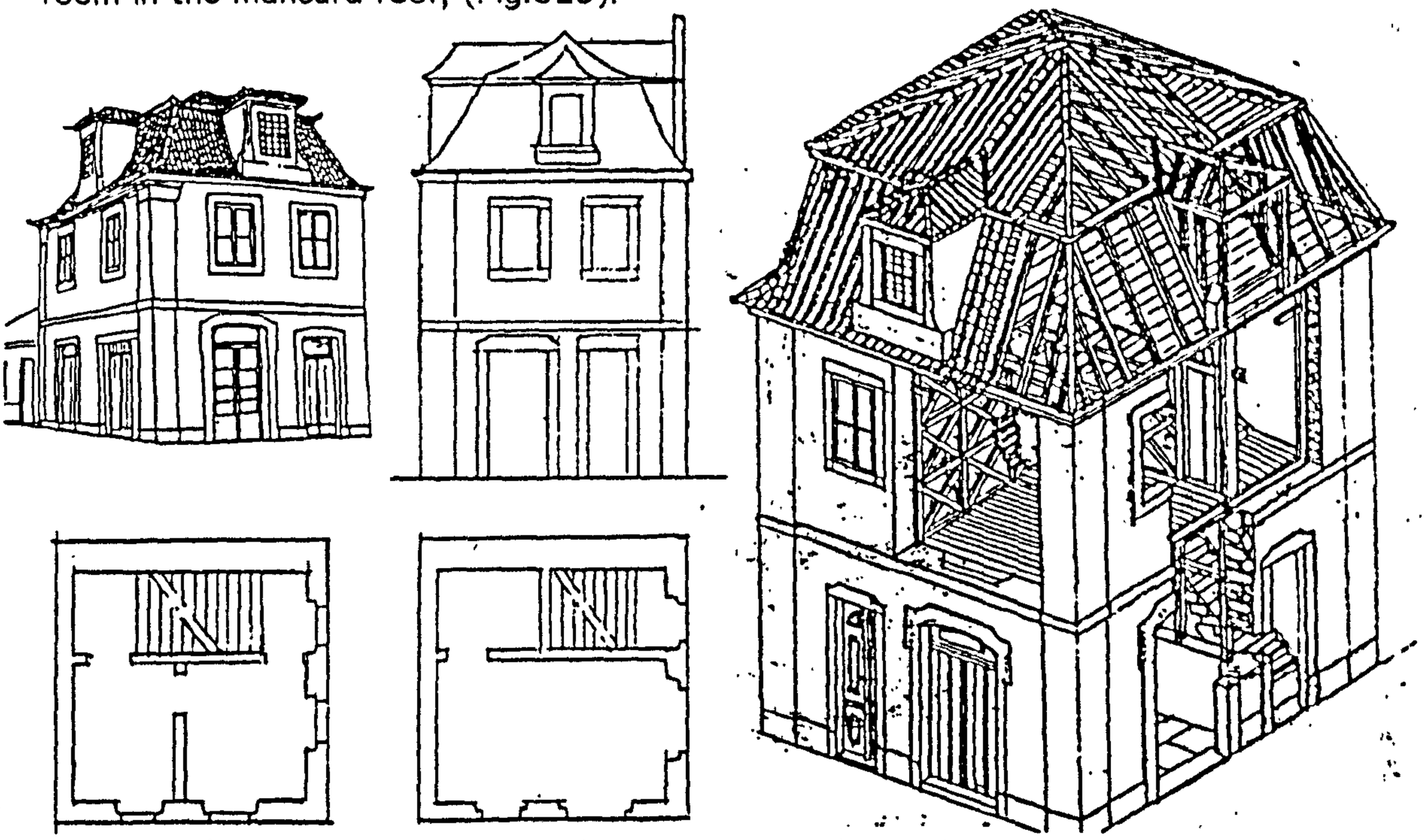


Fig.329-Perspective, elevation and plans and isometric showing construction

The finishings are similar to those of the river front houses (Fig.330), but the structure of the mansard roof is quite complex, (Fig.331 and 332).

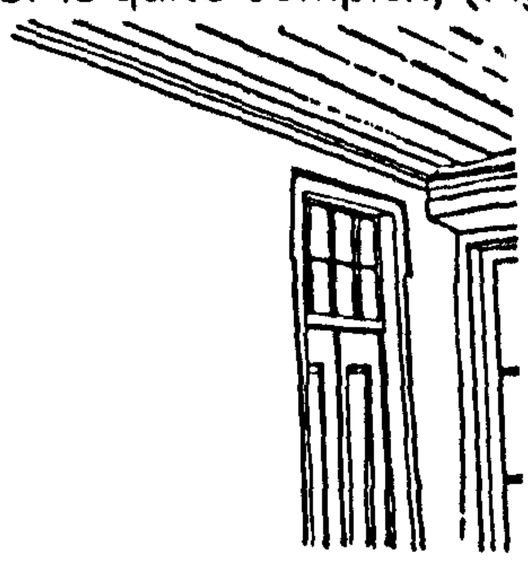


Fig.330-Aspect of the interior

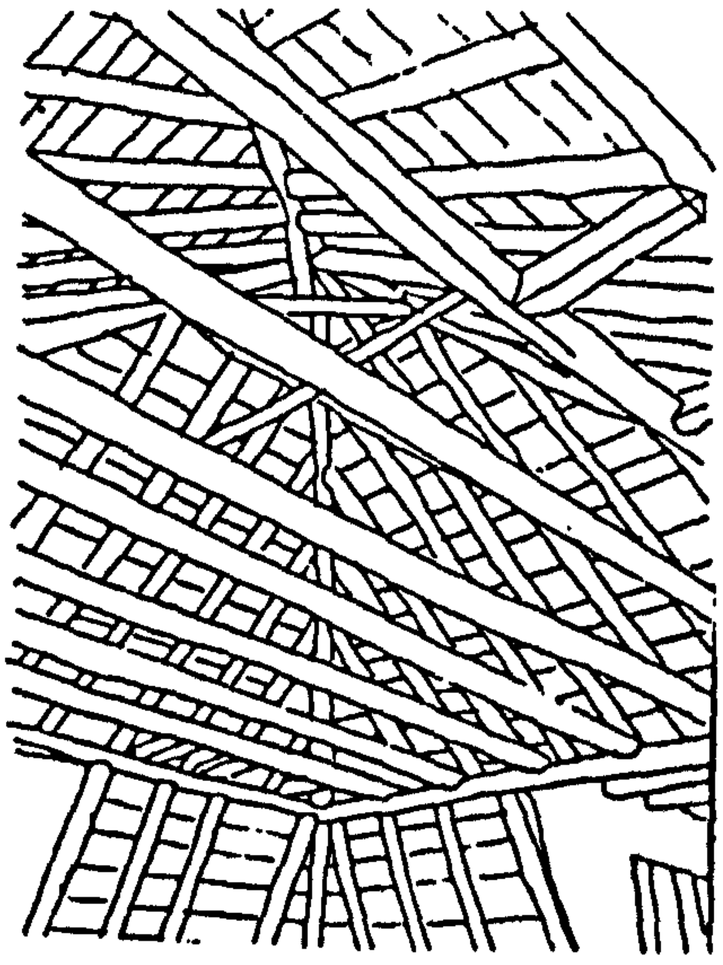


Fig.331-The entrance to the mansard roof accommodation

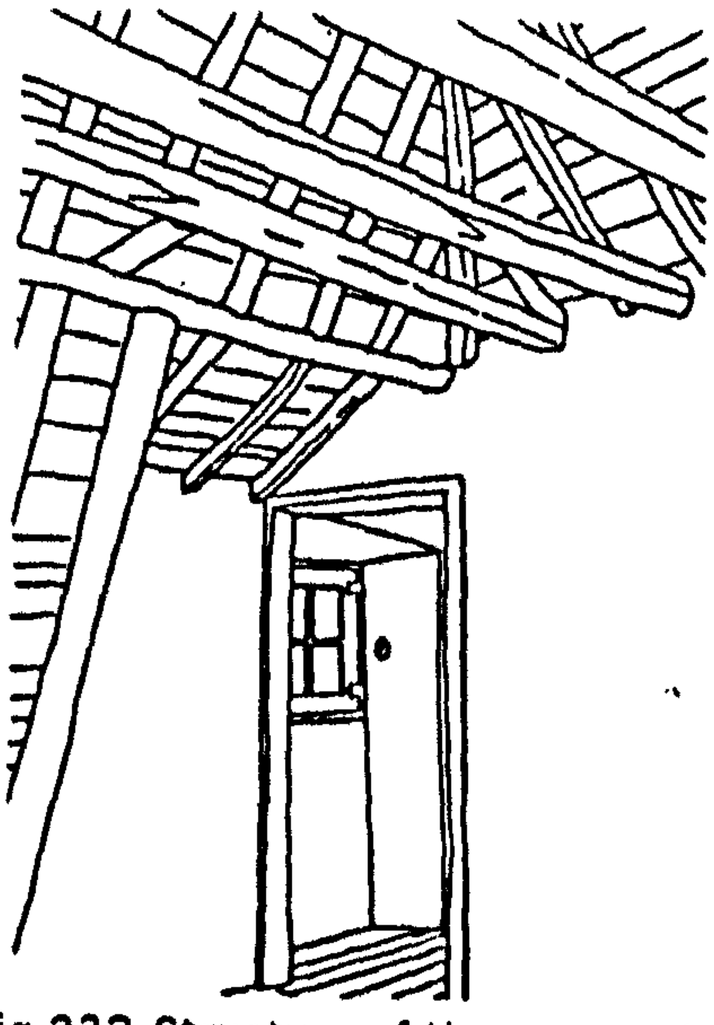


Fig.332-Structure of the mansard roof

The single storey houses: The sixteenth century military roots of the authors of the plan are revealed in the perfect alignment of these houses in blocks.

Their height was 12 palms, the height of the first floor of the houses on the square, edged by a frieze on which the eaves rested. Most of the houses have been altered. The short side of each block was divided into two houses, (Fig.333 and 334). Unlike the Pombaline buildings in Lisbon, here parapets alternate with eaves.

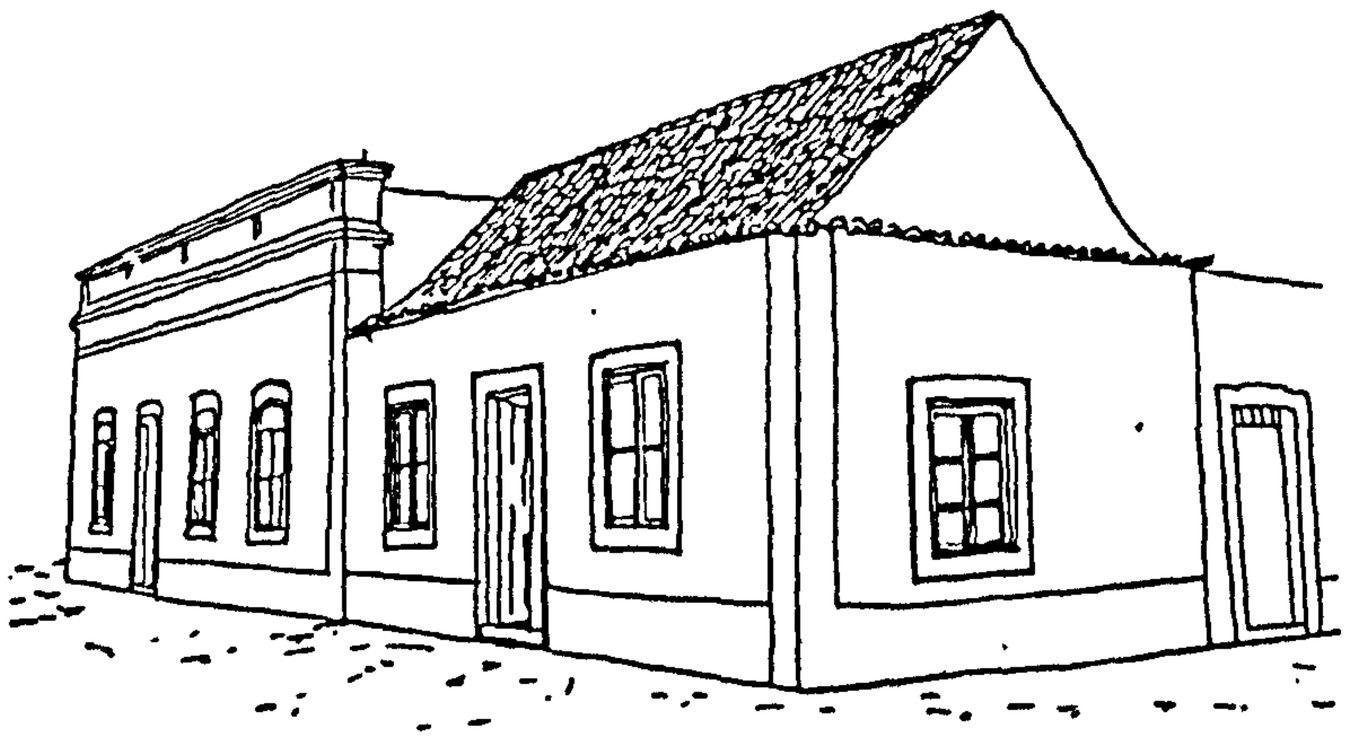


Fig.333-Single storey house

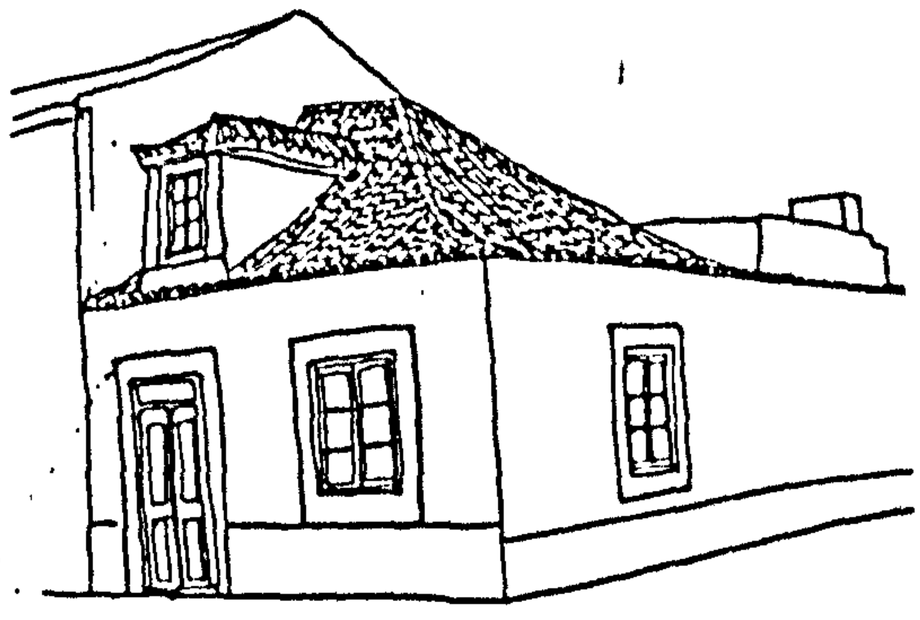
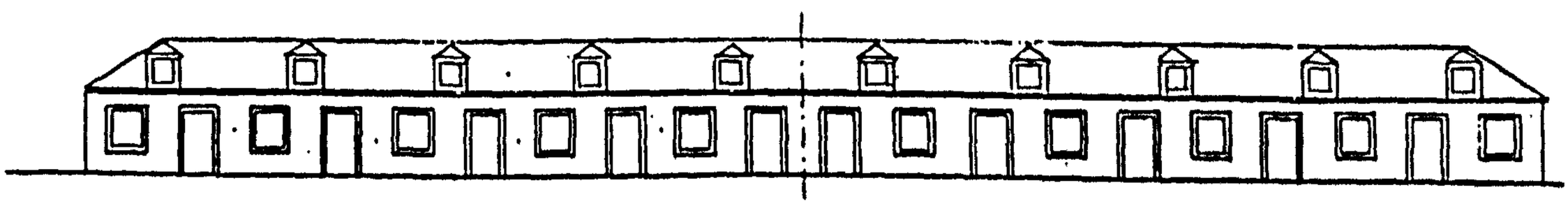
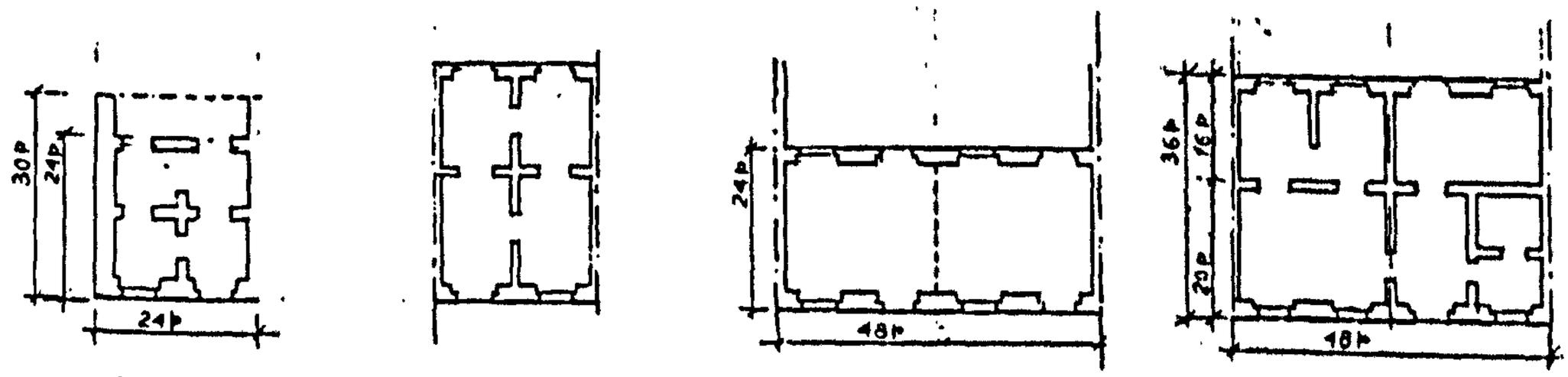


Fig.334-Single storey house with dormer window

In keeping with the smaller scale of the buildings, the window widths were reduced to 5/6 palms, whereas on the squares the windows were 6/7 palms wide. The long sides of each block had two identical halves each with five doors and 5 windows, placed alternately but with "twin" doors in the centre and windows at the ends.

There were four types of houses A, B, C and D, (Fig.335). All the single storey house types had gardens, the size of which varied in accordance with a 10 palm modulation. The length of the garden was planned to allow for extensions. Modulated design has been used to regulate the plans as it has been in the Pombaline Area, but in a rather different way.





Type A Type B Type C Type D

Fig.335-Types of houses

The type A houses have two or three interconnecting rooms, two facing onto the street with a door and a window respectively. The third room, when present, has the same length as the other two combined and faced onto the garden, forming the kitchen area.

In constructive terms, the single storey houses were characterised by their extreme simplicity and the absence of any decorative feature, (Fig.336).

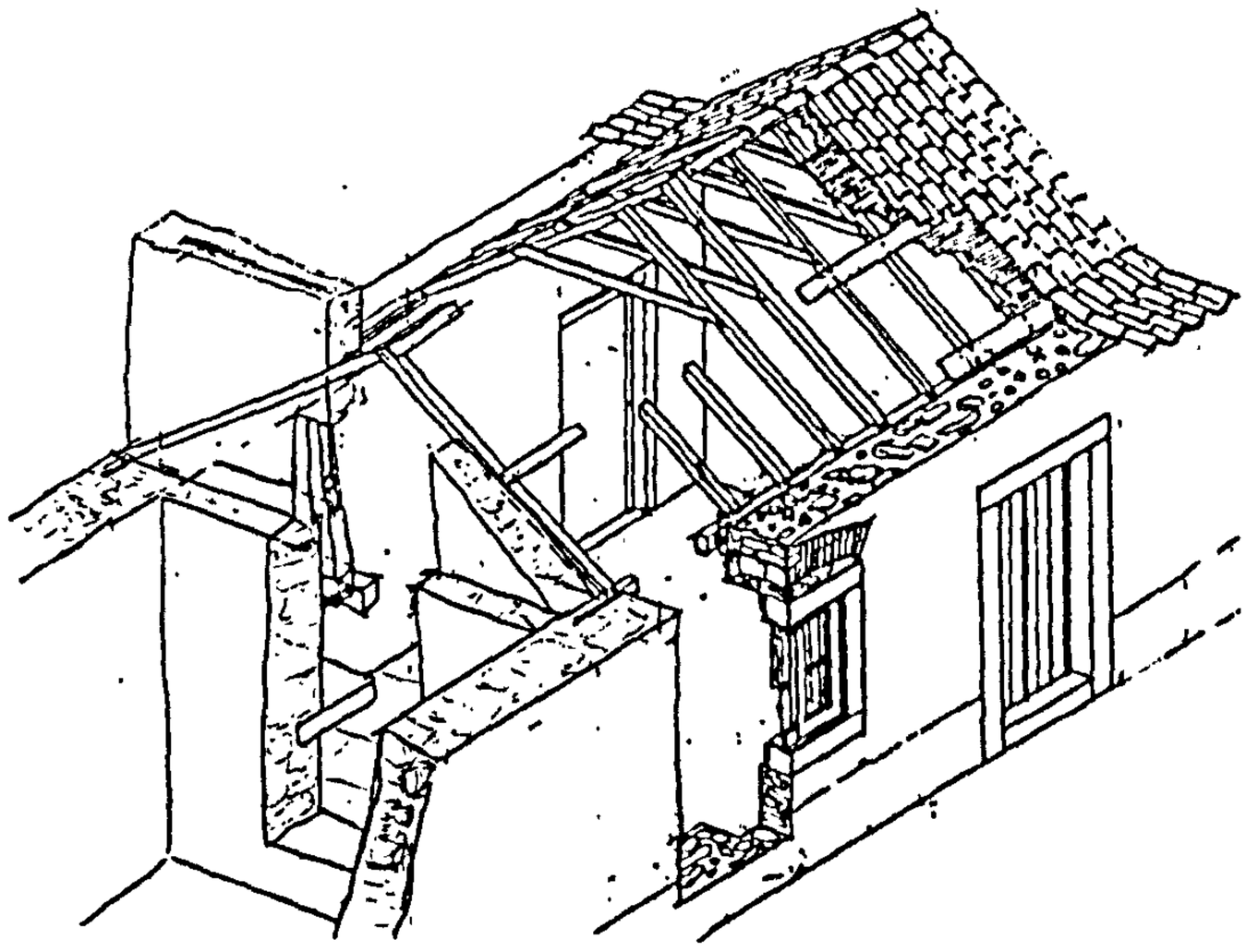


Fig.336-Isometric showing construction

These houses have stone walls on which couples of rafters rest, tied by collars and with no ceiling. The tiles were laid on reeds which helped to insulate the houses. The floors were tiled. The openings, especially the doors, were very simply designed. The stonework on the façade was similar to that seen in Lisbon on less important streets, (Fig.337)

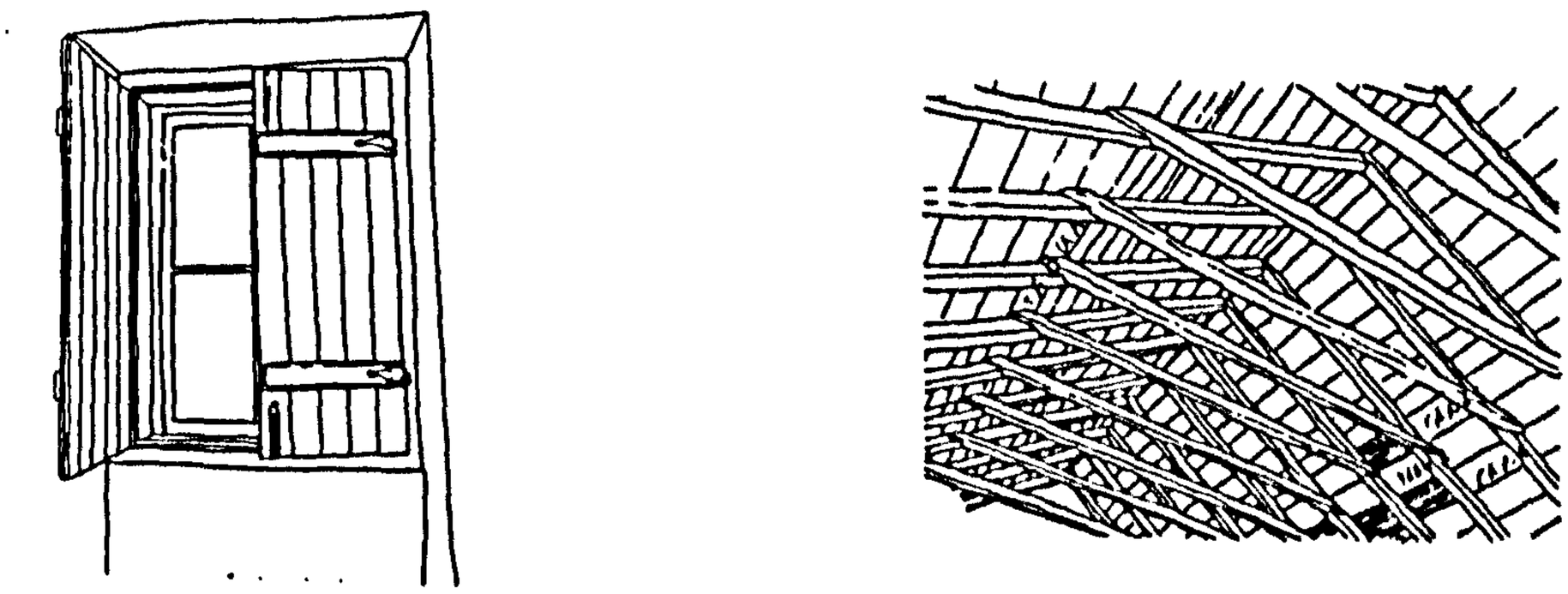


Fig.337-A window from the interior and structure of the roof

V.1.3.2. The construction system

Mass production of building components, a basic principle of Pombaline architecture in Portugal, accompanied by standardisation and pre-fabrication of

components, was also used in Vila Real de Santo António[46]. Due to administrative requirements it was necessary to build a large new town rapidly, in a place where the existing organization in the building sector was inadequate. Many of the stone components such as plinths, quoins, lintels, steps and pilasters, and most of the wooden components such as doors, windows, beams and floorboards were prefabricated, possibly in North Portugal and in Lisbon, and were transported by sea [46]. The components used in the river front buildings are exactly the same in dimensions and form as those used in Lisbon. Those used on other buildings are however different in dimension.

Pre-fabrication of the components was only made possible by the easily permutable nature of the components established at the outset of the project. Thus, for example, the eight palm long stones could be used equally well as doorposts on the façades of the river front buildings and for the first floor windows of the buildings in the square, or even for the ground floor window sills of the buildings in the square or window jambs of the single storey houses.

The form of construction was also very similar to that of Lisbon, the party and exterior walls being in stone, while inside there were timber framed partition walls with St Andrew´s crosses incorporated into them. Arches in brick were used to tie the foundations together and for some walls. Some rooms, especially those next to the stairs, had vaulted ceilings supporting the first floor in order to guarantee greater safety in the event of fire or earthquake.

The stairs rise in the centre of the building, so as to give them greater stability, with two identical straight flights but with the first in stone. The roofs had wooden structures which were covered in tiles.

VI.1.4. Porto Côvo

Between Lisbon and the Algarve there is a large, rich, cereal-growing region which also has substantial mineral deposits. During the period of the Pombaline reforms, an attempt was made here also to develop the economic potential of the region. Early in the nineteenth century, a merchant called Jacinto da Costa Bandeira (1786-1853) sought to turn the small fishing and farming town of Porto Côvo into an important trading post[62]. The choice of Porto Côvo was due to the fact that it was situated next to a natural harbour on a long coastline that is dominated by cliffs. In the First Century, the Romans are said to have used the harbour as an anchorage point and the town as a trading post [59].

In the Archives of the Torre do Tombo it is possible to find the original plan attributed to António Martim Quaresma which was abandoned. The actual urban plan of the town is more simple and practical, with a central square and one main street running from it towards the sea, (Fig.338).

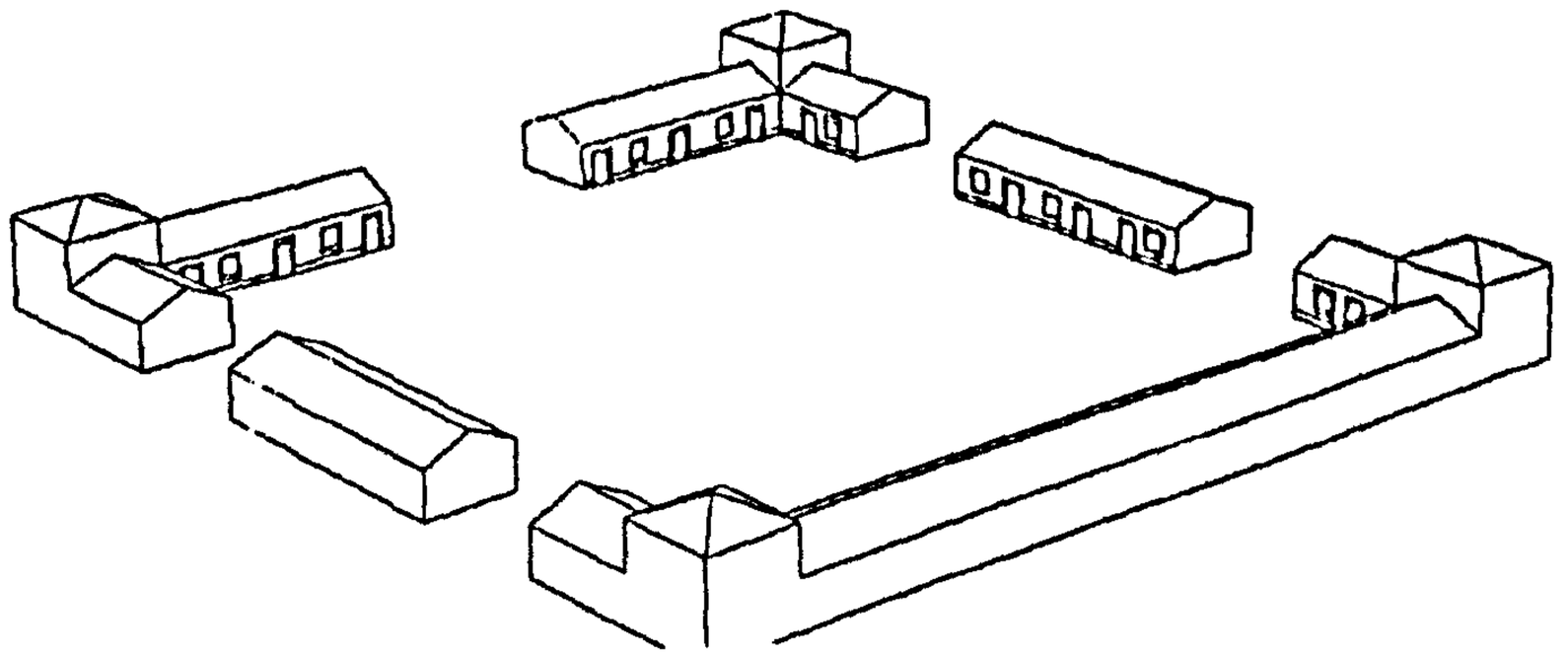


Fig.338-The plan of Porto Côvo

The whole urban centre is made up of numerous single storey houses all aligned (Fig.339), with the exception of the four houses at the corners of the square which have two floors (Fig.340), similar to the square of Vila Real de Santo António.

Fig.339-The square

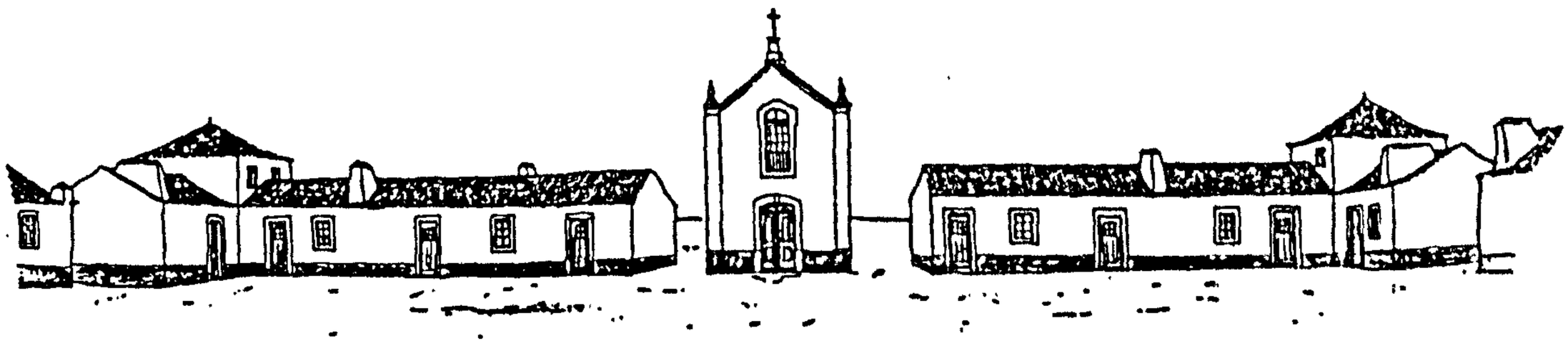


Fig.340-The square (South side)

From an architectural point of view we can see the typology of traditional housing in the region being adapted to a repetitive scheme and built in a rational manner, using the same principles of austerity as in Lisbon, (Fig.341).

In the square each house had a window and a door at the front; the openings had projecting lintels, jambs, and sills or doorsteps in stone which like the plinth were painted with a blue oxide; the houses were not distinct from one another since the façade and the eaves were continuous. As in Lisbon the symmetrical dual pitches were punctuated, but by chimneys in this case rather than by parapet walls as in Lisbon.

There is a great variety of heights and forms in Porto Covo compared with Lisbon, for example the two-storey towers in the corners of the square, the different scale of the church compared with the rentable buildings and its focal position in the square.

Generally speaking, the majority of the houses consisted of two equal rooms, similar to those of Vila Real, with a back garden. The main room had two doors, one onto the street and the other at the back, and an enormous fireplace where food was not only prepared and cooked but also eaten (Fig.342 and 343). Unlike the Pombaline area and Vila Real, here the interiors are repetitive.

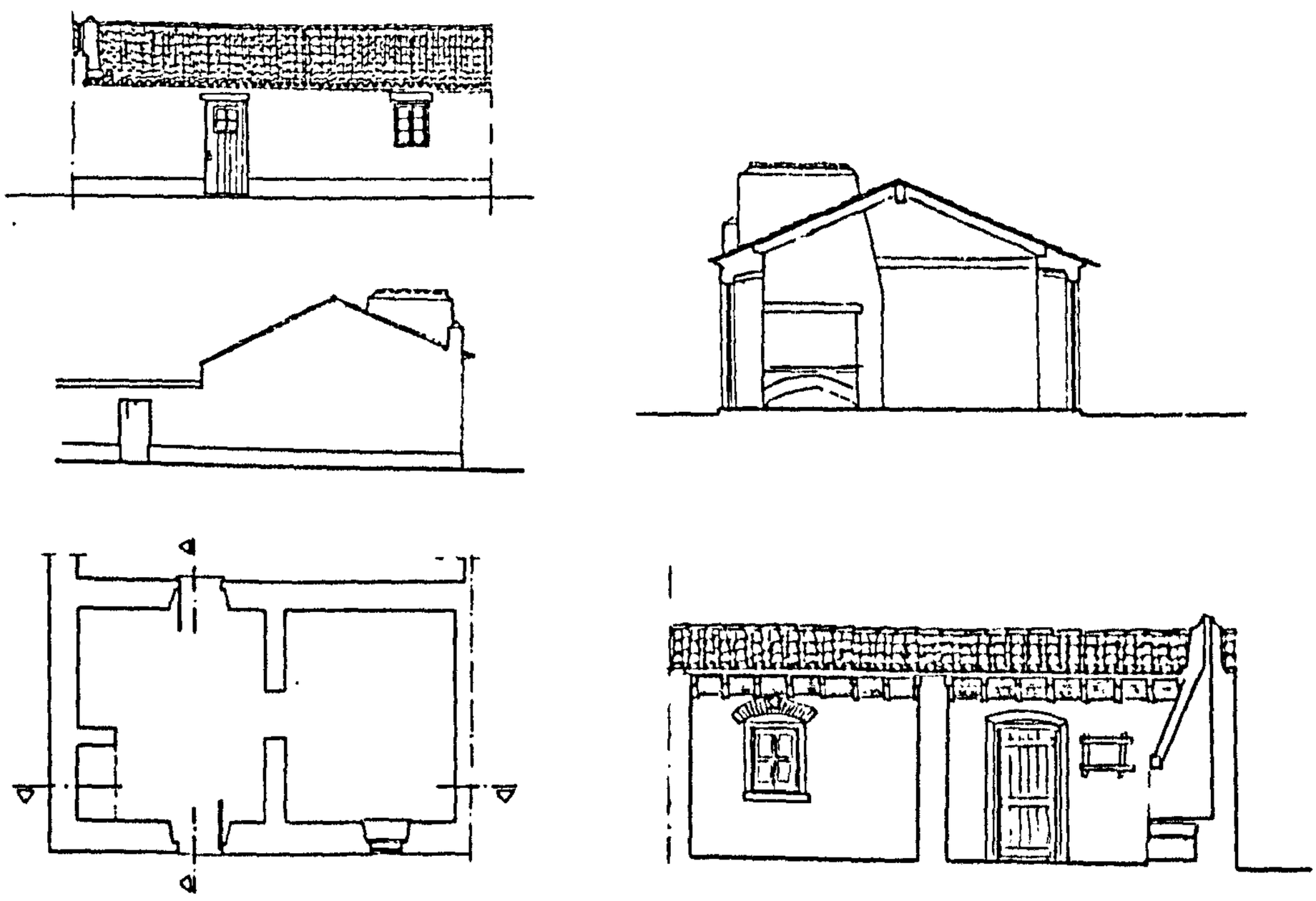


Fig.341-Ground floor house, elevations, sections and plan

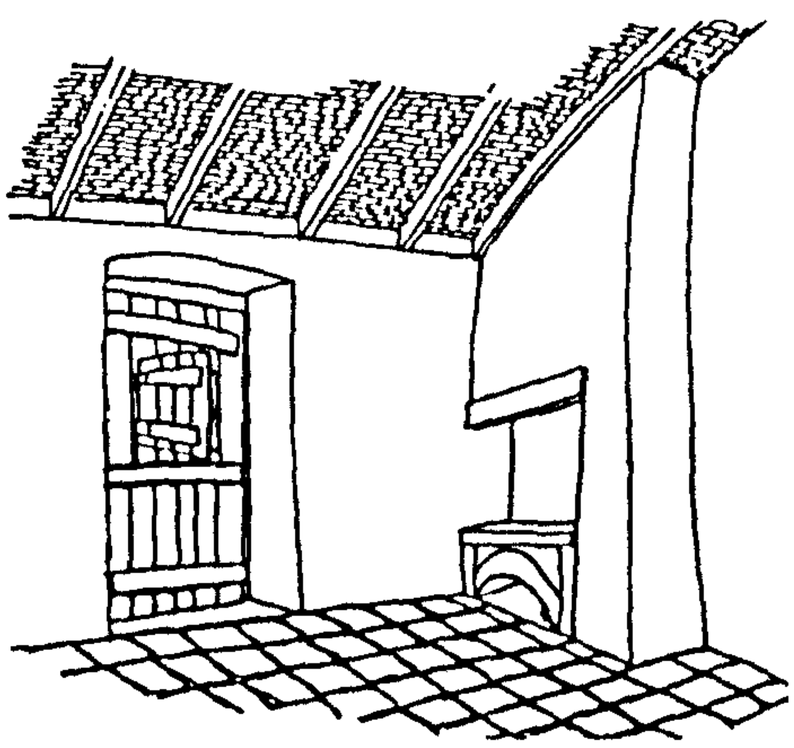


Fig.342-Aspects of the interior

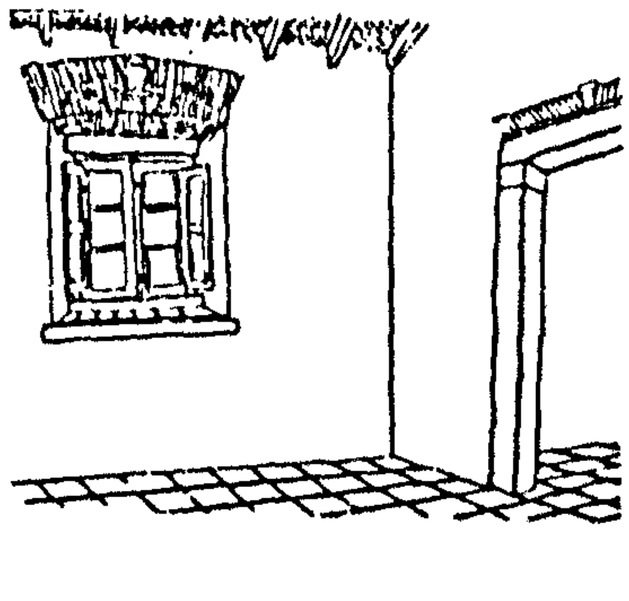


Fig.343-Aspects of the interior

In constructive terms, the walls of clay, lime and stones were whitewashed both inside and out, (Fig.344). The external walls were thick but the partition was thinner. Given the fragility of the material of which the walls were made, all the openings had relieving arches above the lintels. The roof structure was timber, consisting of a ridge tree and pairs of rafters.

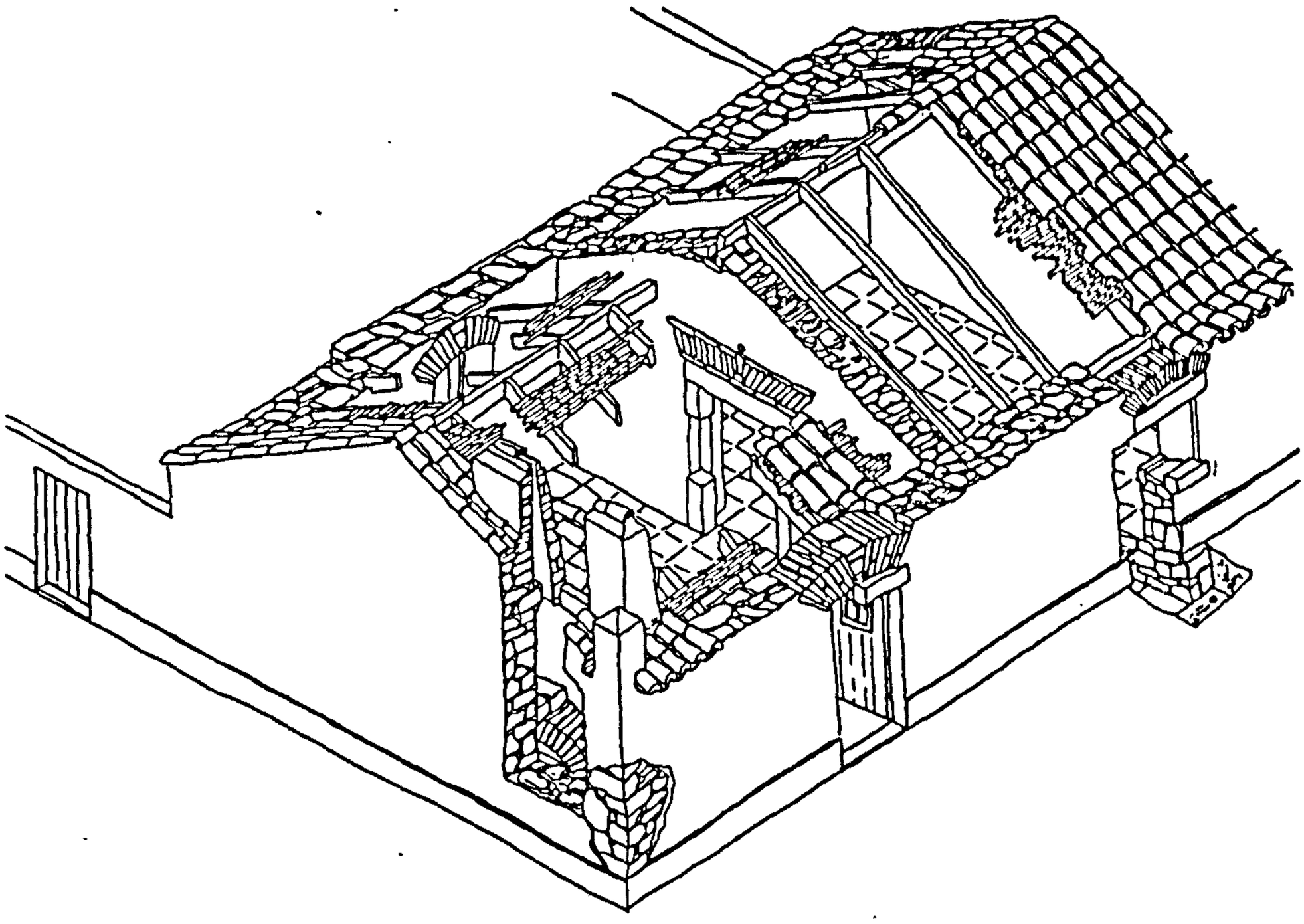


Fig.344-Isometric showing construction of single storey house

Two storey houses

These houses, on the four corners of the square, are similar in some ways to the ground floor houses. The upper floor with a complex roof structure housed a single room, (Fig.345 and 346).

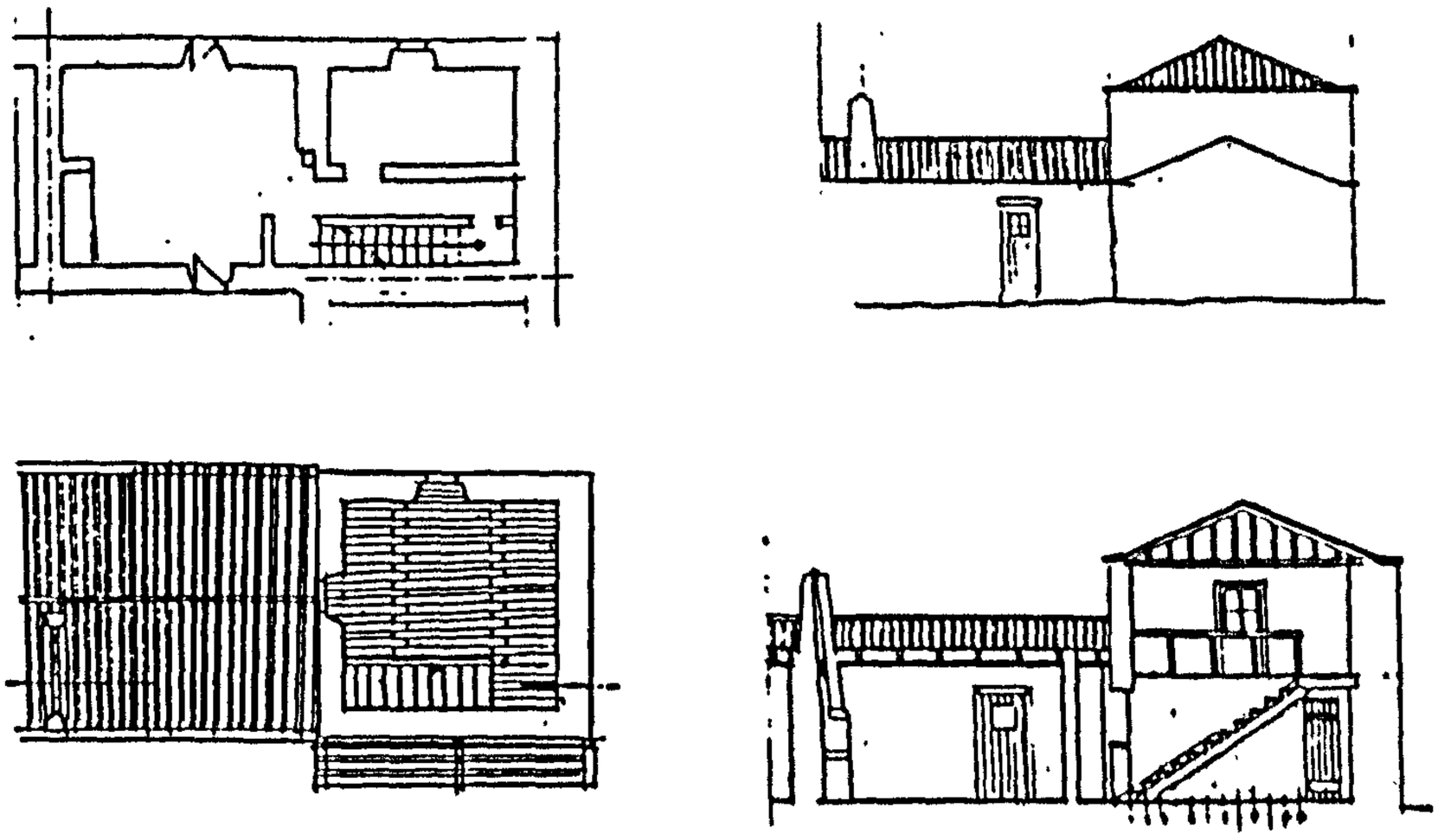


Fig.345-Two-storey house, plans, elevation and section.

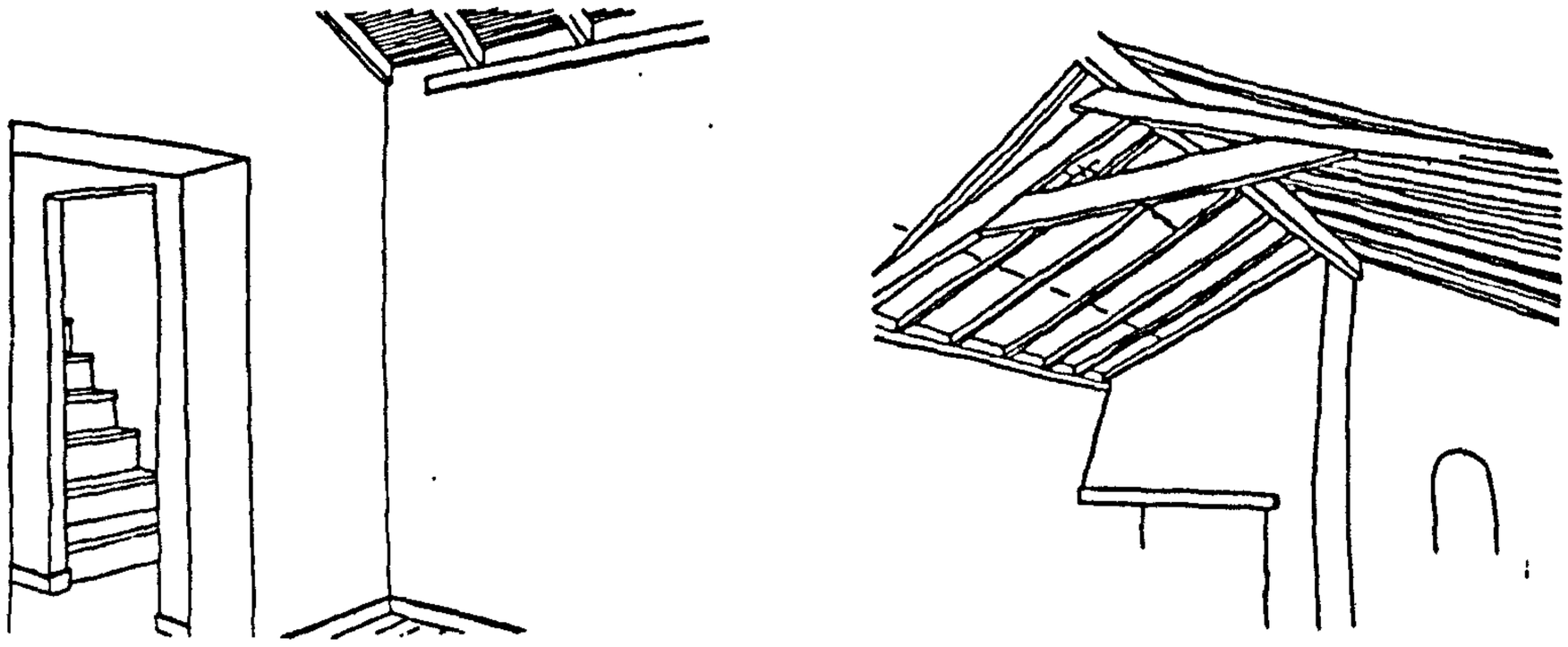


Fig.346-Aspects of the interior

VI.1.5.Manique do Intendente

The creation of Manique do Intendente is attributed to a Police Superintendent during the reign of D. Maria I, called Pina Manique, who, being from the area, is said to have wanted to build a town that would accommodate workers and their families to develop a very rich agricultural region, [60, 61] at the end of eighteenth century.

The authorship of the plan in questionable, but is attributed to José da Costa e Silva. It is defined in urban terms by an unpaved central hexagonal space (Fig.347), the Imperial Square, defined in turn by four trapezium shaped residential blocks, with a column in the centre and the Town Hall building (now a police headquarters), on the North side of the hexagon, (Fig.348).

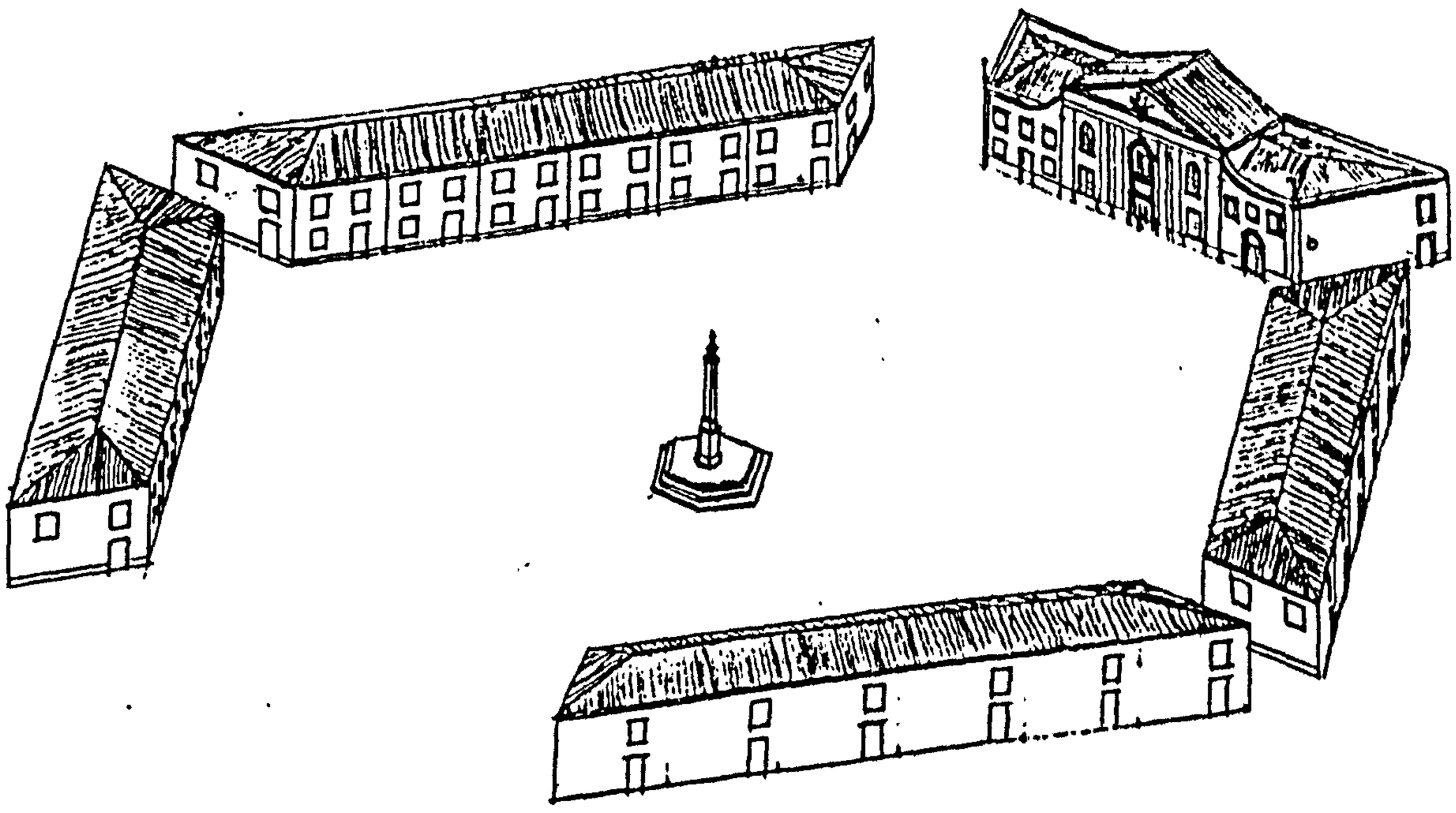


Fig.347-Isometric of the Pombaline development of Manique do Intendente

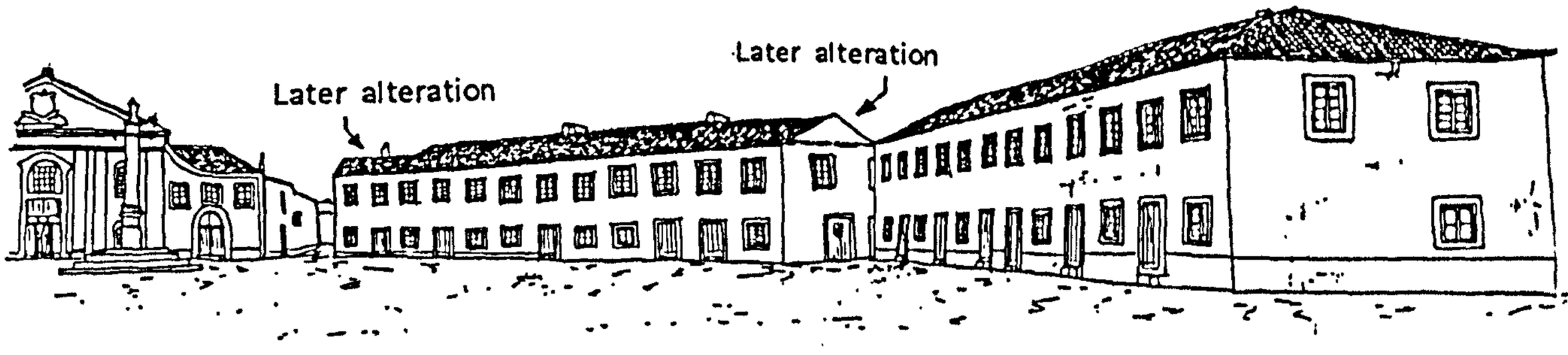


Fig.348-The square

The rentable buildings in the square are terraces of two storey houses with no courtyards or garden at the back. Each block consists of seven buildings, five of which are rectangular while those at the end have greater areas and a trapezium shape. The composition of the façade is very simple, each building has a ground level with two openings, one door and one window, and on the upper level there are two windows that line up perfectly with the openings on the lower level. All the openings are surrounded by dressed stone work with a stone plinth at the base and eaves above, (Fig.349 and 350)

Compared with Lisbon there is a greater diversity of form and space exemplified by the hexagonal central space and the trapezium plan-shape of the blocks. As with the Church in Porto Covo and the Customs House in Vila Real de Santo António, there is considerable contrast in both scale and lavishness of ornament between the Town Hall in Manique and the residential blocks. There is no hierarchy of buildings and there are no dormer windows or *alfugeres*.

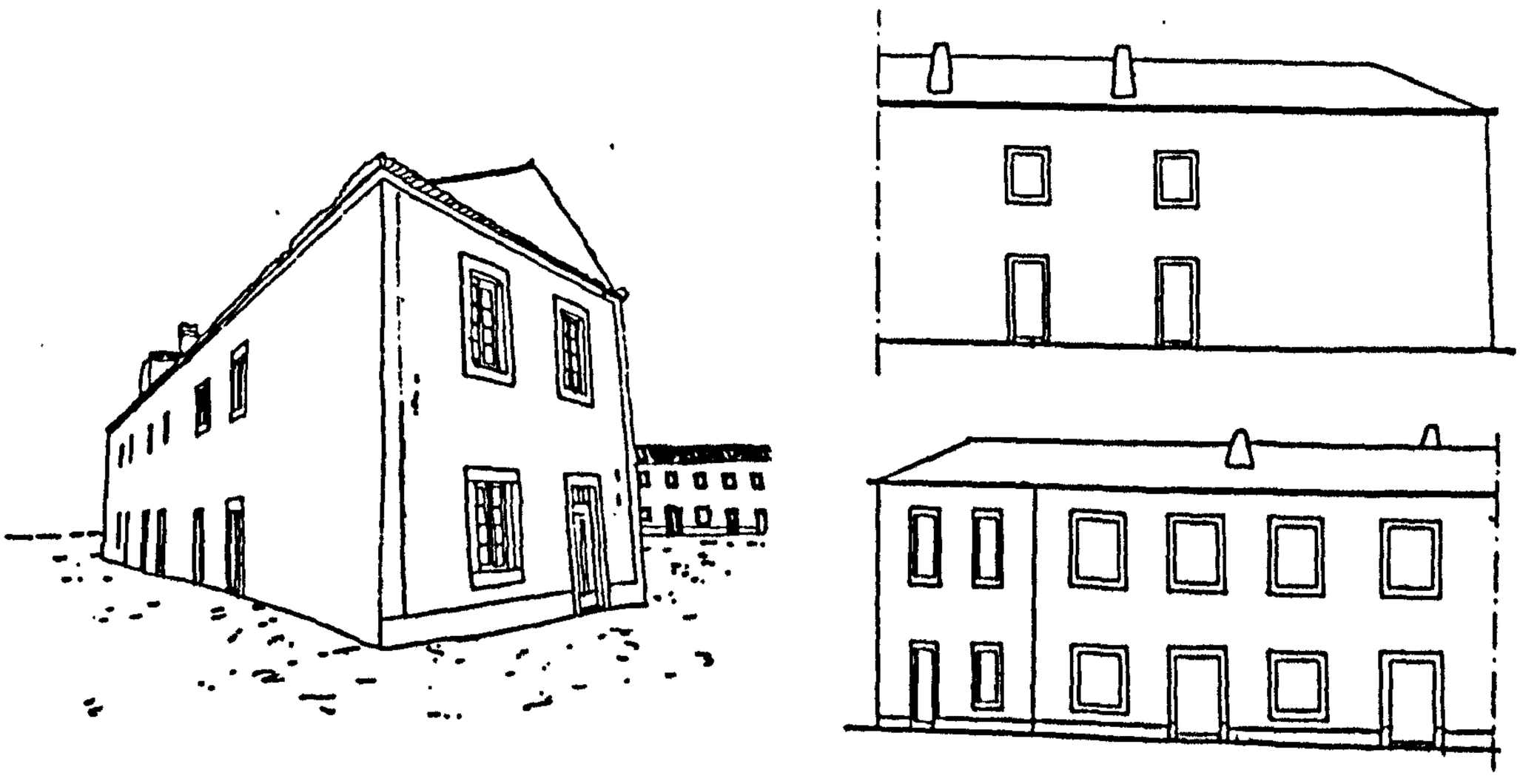


Fig.349-View from the back and elevations.

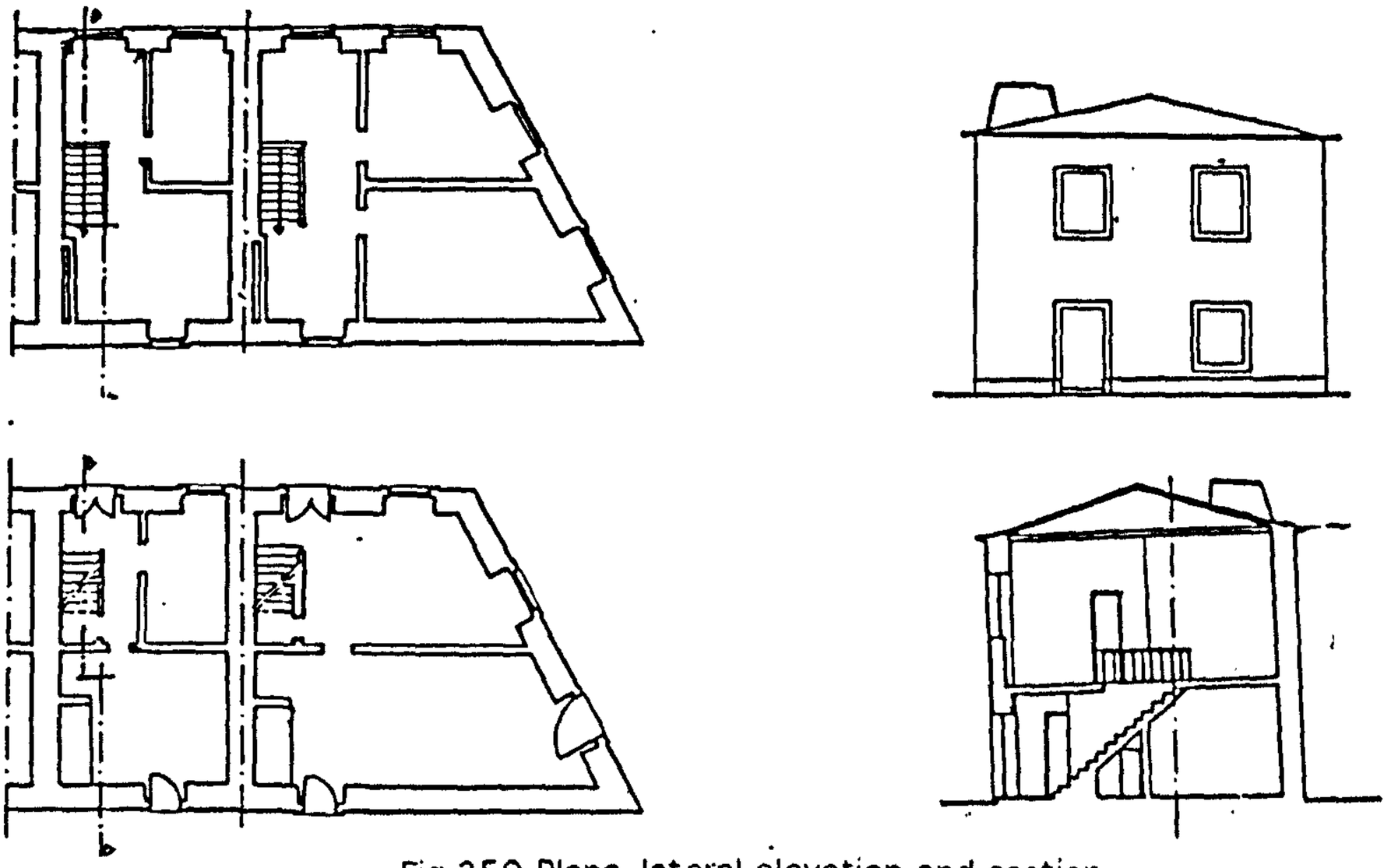


Fig.350-Plans, lateral elevation and section

As in Lisbon all buildings have the same height, but there is no variation of details of facades. Although the overall plans and overall building forms are more varied than the Pombaline quarter, and could be considered as "Baroque" by comparison, the same principles of austerity and repetition as in Lisbon can be seen in the façade design.The interior is also extremely simple, (Fig.351, 352, 353 and 354).

Fig.351-The entrance to the kitchen

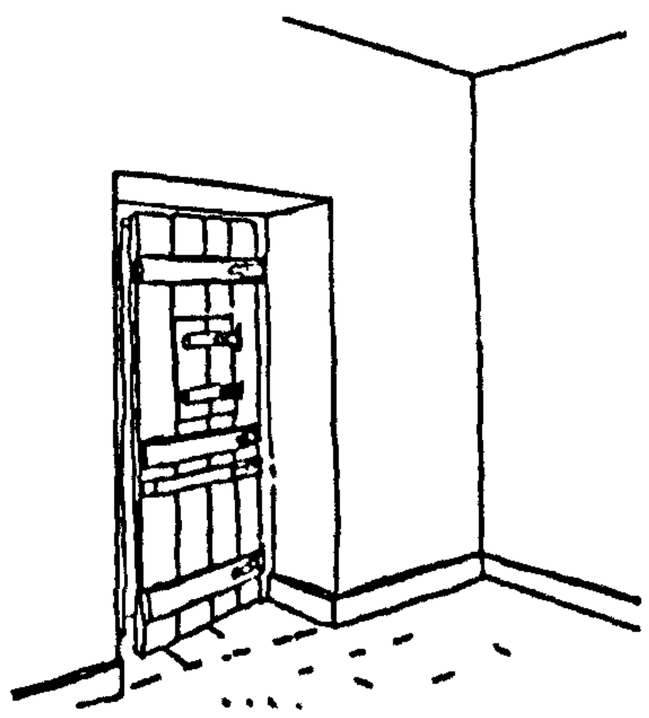


Fig.352-An external door

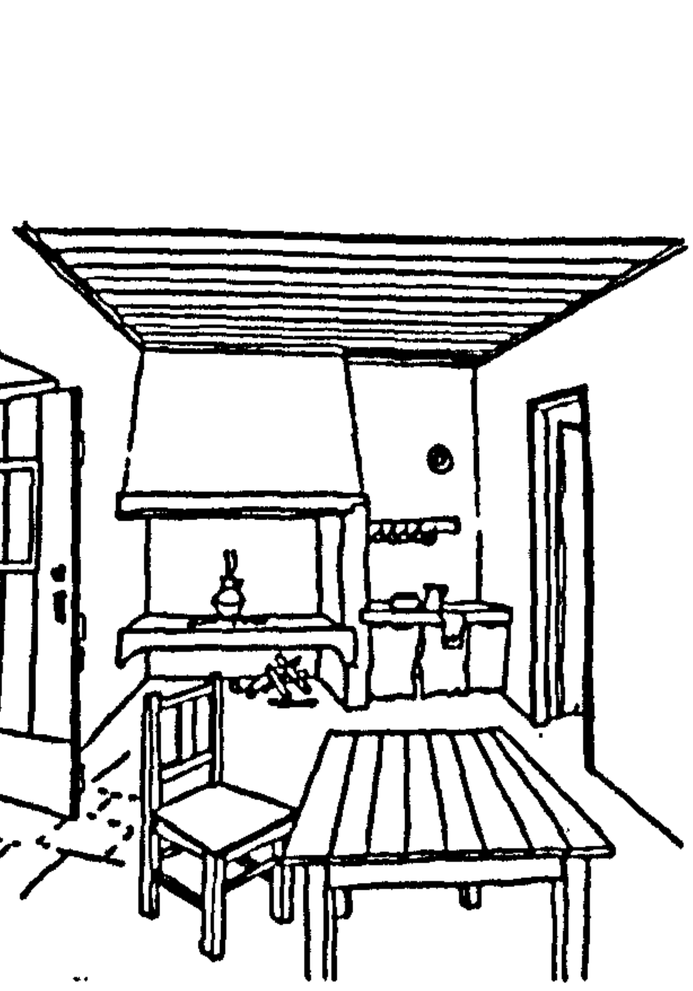


Fig.353-The kitchen

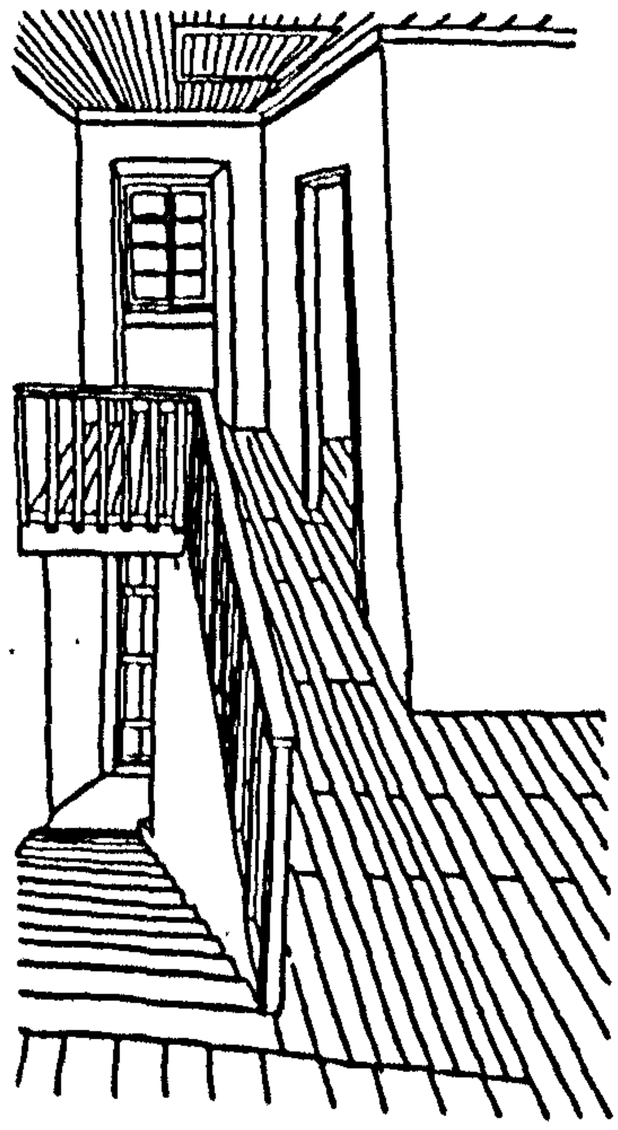


Fig. 354-The stairs

The modulation of spaces was established in a simple way: half of the total area of the ground level was occupied by the kitchen, a quarter by the sitting room and the rest by the hall and the stairs. On the upper level there was a room which had the same area as the kitchen and another smaller one identical in size to the sitting room, thus there was a perfect alignment of the internal walls on the upper and lower levels. Unlike Lisbon and Vila Real the interiors are repetitive without any variation.

The stairs were a single straight flight of fifteen steps and fitted in between the two walls. On the upper floor the landing was protected by a wooden balustrade. The floors were all in wood as were the ceilings; the internal walls were thin wooden partitions without any stonework. The outer walls were of brick and thicker on the lower level, (Fig.355).The houses are finished in a very simple style with no skirting boards, in a similar manner to those of Vila Real.

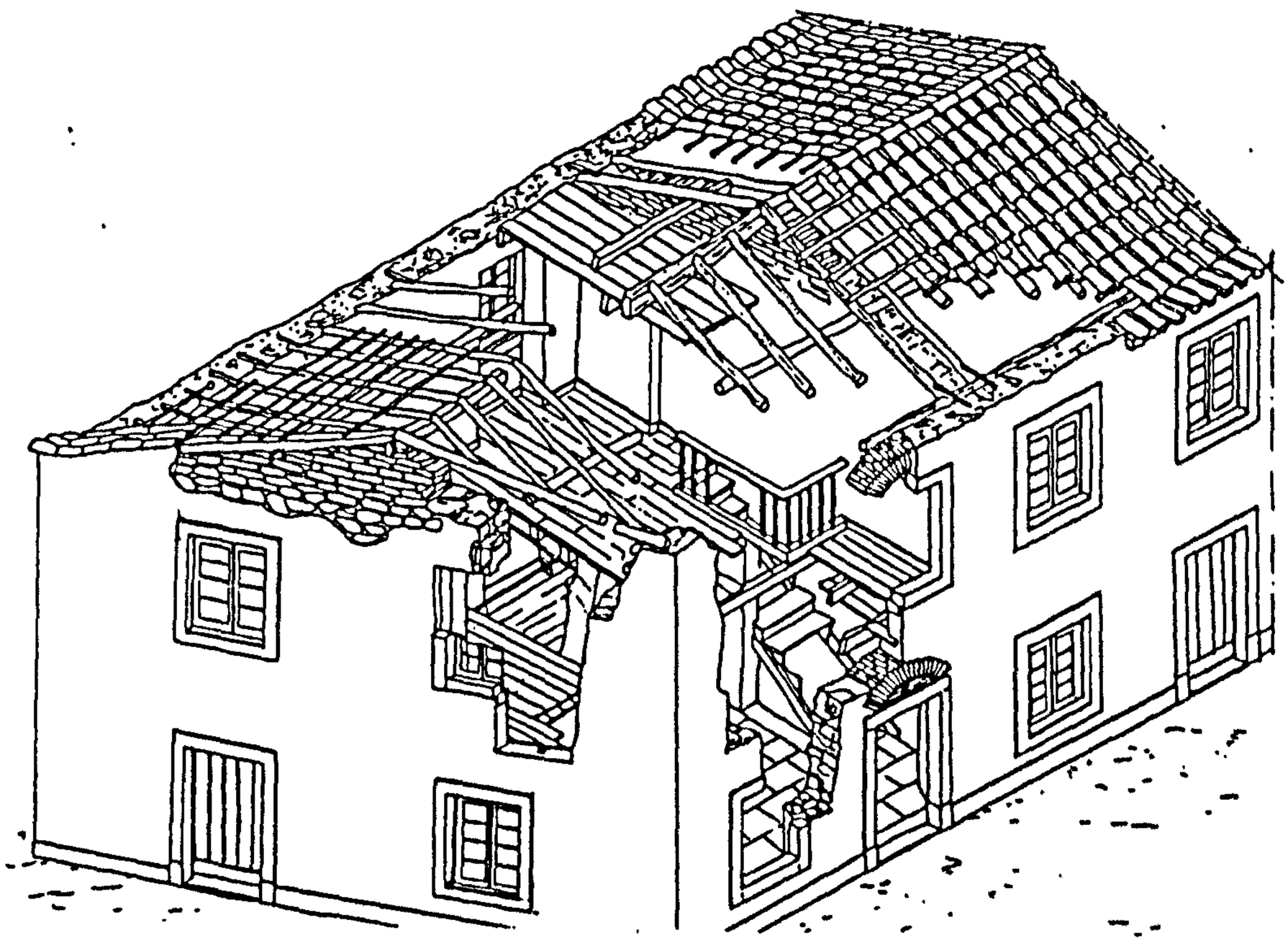
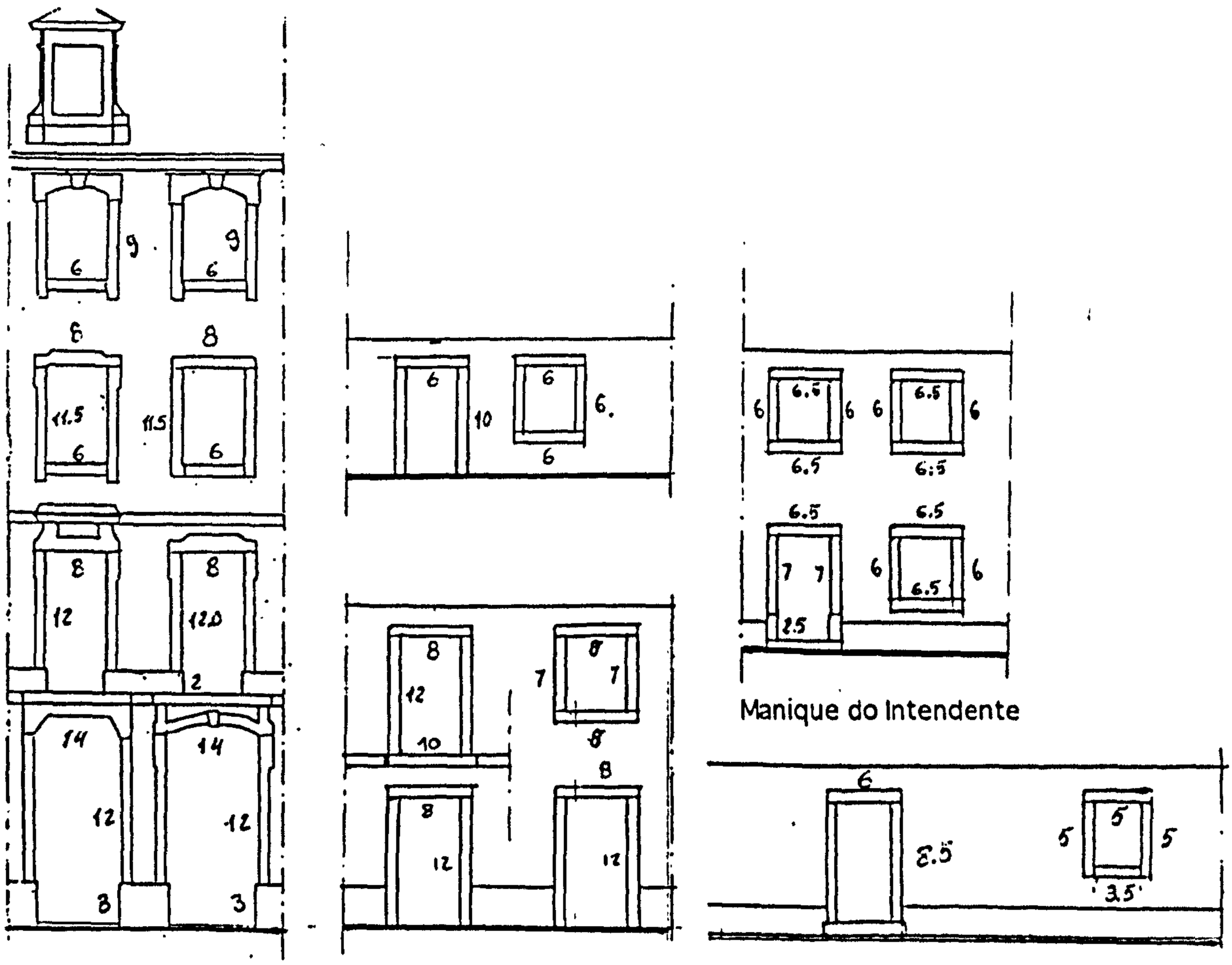


Fig.355-Isometric showing construction

The Pombaline area in Lisbon is richer in variation of details of compositions, as in the case of the elevations. In common, however are the principles of simplicity, repetition, economy and standardization. The dressed stone window and door surrounds are not identical in all the developments, but there are some common sizes and the palm is the common module. (Fig.356)



Lisbon Vila Real Porto Covo

Fig.356-Comparison of dimensions from elements of façades

VI.2. The Pombaline architecture as architecture of rentable buildings

The new Portuguese urban developments of the later eighteenth century appeared at a time when the construction of palaces, public buildings, or churches took second place, since throughout this period of austerity, in an attempt to lead the country towards economic recovery, priority was given to utilitarian blocks of rentable buildings.

Pombaline architecture, in stylizing, systematizing and homogenizing the pre-existing elements, in a rational way, found a form, a complexity and an elegance of its own.

The architects and engineers with their military background, removed from an explicitly artistic environment, opted for a neo-classical style, more out of functional necessity than theoretical choice, returning to the values of the architecture which had previously been adopted during a period of economic austerity, the "Chã" architecture.

This was not the architecture of outstanding buildings but the type of architecture which is born under the sign of urbanism where the fundamental typology was the rentable building. It was a period in which churches were considered to be of little or no importance when compared with the preceding periods.

As the construction of whole blocks of buildings in Lisbon continued for many years, it is difficult to distinguish individual attributes. However, it is possible to find in the style the characteristics, which are:

i. The buildings were always grouped in blocks with repetitive modulated façades.

ii.The hierarchy of buildings is established only through the variation of minor details.

iii.A practicality in terms of construction is evidenced by a great simplicity and repetition.

iv.Technical innovations against earthquakes are incorporated in the form of an anti-seismic structure.

v. A standardized construction is adopted to facilitate prefabrication.

vi.A careful selection of traditional components without decoration is made in order to achieve maximum flexibility, adaptability and ease of assembly on site.

vi.There is a great variety of interiors; the plans are different from one building to another.

VI.3. Summary

The urban developments described above were all planned and built under the Enlightened régime of the Marquis of Pombal. The period was dominated by rentable buildings always grouped in blocks within a rational urban plan. Whilst, however, the Pombaline quarter is characterised by extreme repetitiveness, uniform building height and elevational treatment and a completely orthogonal plan, the other three developments all have greater variety of one kind or another, giving them a character which could be described as "Baroque", as opposed to the "Classicism" of the Pombaline quarter.

In Vila Real and Porto Covo, the "Baroque" character is achieved through the punctuation of the residential blocks by "tower" buildings, and in Vila Real, by the contrast between parapets and eaves in the single storey houses, and the variety of form given by the arcaded salting houses. In Manique do Intendente, the "Baroque" character is generated by the use of the hexagonal central space and trapezium shaped blocks. In all three developments, focal points are provided by public buildings which differ radically in height, scale and lavishness of ornament from the rentable buildings.

In the Pombaline quarter, the public buildings in Praça do Comércio are far more richly ornamented than the rentable buildings, and they are given a grander scale by the use of a classical order extending over two storeys, but their identical overall height with the rentable buildings ensures a substantial homogeneity.

The strict adherence to both earthquake and fire precautions in the Pombaline quarter of Lisbon diminished to the observance in Vila Real of anti-seismic measures only. By the time Porto Covo and Manique were planned, even these seem to have disappeared, although possibly this can be attributed to their smaller scale.

Nevertheless it can be seen that the extreme practicality and austerity of the Pombaline quarter of Lisbon soon gave way to a richer variety of contrasting form and scale. At the same time, paradoxically, the variety of internal layouts in Lisbon and Vila Real gave way to repetition in Porto Covo and Manique do Intendente.

Perhaps the most lasting influence of the Pombaline quarter of Lisbon was the standardisation of window and door components and even more, the developments of symmetrical internal layouts frequently with staircases serving two flats on each floor, the rooms of each flat being accessed independently from corridors or hallways. This contrasts with the previous arrangements of staircases serving a single flat on each floor and within each flat, interconnecting rooms.

In Britain the change from interconnecting rooms to independent access to each room, from a central hall, linking with the staircase and the entrance, is seen as a change from sub-medieval to Renaissance layouts(63).

CHAPTER VII
DISCUSSIONS AND CONCLUSIONS

VII.1. The creation of the Pombaline rentable building in relation to the prevailing political and economic climate.

Unlike that which often happens to cities that have been destroyed by earthquakes, (which are either abandoned or are restored to their original state without major changes in concept or design), the centre of the city of Lisbon was totally transformed and the same unstable site was chosen to rebuild the city.

The decision to reconstruct the city on its previous site supported the interests of the new ascendant bourgeoisie. In the new plan there was no place for palaces for the nobility and churches were reduced to the same dimensions as the rentable buildings. The prohibition of rebuilding outside the city walls, increased trade demand and the values of land belonging predominantly to the middle class. During the complex transfer of property from the old grid to the new one, there was evidence that the process reinforced the interests of the new rising class. For example, small property owners had priority over the large ones and if they gained more space over other proprietors they were allowed to compensate with cash rather than property. (see Section I.12). The chosen plan from the six considered, was the one prepared by Captain Eugénio dos Santos. This consisted of an orthogonal grid, which offered a more functional system to accommodate the extensive shop façades to the street and the economic interests of the owners, and also provided better and safer conditions.

Due to the particularly difficult circumstances, the Marquis of Pombal, the prime minister, relied on the expertise of architects and engineers with military background such as Manuel da Maia, Carlos Mardel and Eugénio dos Santos. Their influence marked the "Pombaline Style" by its austerity, rationality and practical necessity(see Section I.11). During this period of economic crisis, precipitated by the earthquake, Portuguese Architecture again took refuge in a style dominated by repetition and the play of proportions. The simple and austere rentable buildings had their origins in the simplicity, proportion and repetition of the preceding austere period of architecture, the Architecture "Chã", (1580-1700) (see Section I.9).

The mass-production of components used in the buildings from the social point of view, made it possible to level out external differences because it allowed most proprietors to achieve certain standards and levels of quality. The rebuilding programme created an economic and practical form of construction accessible for the first time to a much wider cross-section of the population.

There is no doubt that the reconstruction process encompassed several mechanisms which reinforced the position of the new rising class, (see Section I.12), and the Pombaline Architecture as "Chã" Architecture, was a return to the frugal principles of the traditional architecture, in a period of great austerity.

VII.2. Innovative elements of the Pombaline Rentable buildings.

The decision to rebuild on unstable land and the necessity to minimise the effects from future possible earthquakes and consequent fire, stimulated many improvements and technical innovations providing also better living conditions (see Chapter IV).

The reconstruction was defined and regulated by precise rules and procedures right from the start at both the urban planning and architectural level. The imposition of orthogonal plans over an existing plan, was similar to contemporary new colonial cities such as México City (1688), Quito (1734) and Caracas (1750), with two large squares at the ends of the main streets enabling rapid escape from earthquake or fire (see Section IV.1). The rectangular blocks were generally aligned in a north-south direction to better withstand any tremors which tended to propagate in that direction in the area. Strict rules were imposed for the height of buildings and width of streets, with separated zones for vehicles and horses, and pedestrians, and with rigorous alignment of the façades. This would avoid possible injuries caused by collapsing of buildings and would make fire fighting easier (see Section I.8.3). In order not to hinder the escape of inhabitants, the profusion of decorative or utilitarian elements from the façades was not allowed. Separating the backs of the rows of buildings was a free space, the alfugere, where rubbish could be deposited and people would be more easily rescued in the event of a disaster. The wider streets and the alfugeres also allowed better daylighting and ventilation (see Section IV.1). The instability of the land caused by the domestic waste and waters from the neighbouring hillsides were avoided by the creation of a sewage system (see Section IV.1).

In order to prevent the buildings from being damaged by a further possible earthquake, several features were included in their construction. An ingenious foundation system was created making use of solid arches supported on short timber rafts. Additional stability was given by vaults over the ground floor supported on thick stone walls and pillars (see Section IV.1). The height of the rentable buildings was established as the same as the Public buildings of Terreiro do Paço (see Section

III.1) with a commercial ground floor 16 palms in height and the remaining height divided into 3 floors. The composition of facades was conceived with a rigorous alignment of openings achieving a perfect balance of forces (see Appendix 6). To be able to construct a stable structure of three floors in height, a wooden structure or cage, which had already existed before the earthquake, was perfected and applied systematically with a complex network of struts (see SectionIV.1). The elasticity of its connections would absorb the vibration of a quake. It would also allow more rapid construction (see Section IV.1). The external walls of the façades were tied into the cage in such a way that in the event of a severe quake the external walls would be released from the rest of the building without putting at risk the stability of the whole building, and the inhabitants could remain in the relative safety of the interior sections or compartments (see SectionIV.1). The stairs were positioned preferentially on the axis of the building thus increasing its stability.

Other innovations were adopted in rebuilding the centre of the city as a result of the unusual and exceptional circumstances created by the disaster and also as a result of the need (for economic and social reasons) to rebuild in a short time period with a great shortage of materials and of specialized labour (see Section IV.2). The urgency and scarcity led to the development of new concepts and innovative methods, which involved elements of dimensional coordination, standardisation, modulation and mass production.

The approved plan followed a number of rules of proportion underlying the dimensional coordination and standardisation. For example, the urban plan was based on a series of Golden Rectangles enclosing rectangular blocks of buildings bounded on all four sides by streets (see Section IV.2.1).

The modulation of the facades, which conforms to regulated, geometrical relationships, not only gave equilibrium, rhythm and harmony but also allowed adoption of standardized construction processes for which the palm was the basic repeat unit of measurement (see Section IV.2.2.). In general the overall lengths and widths of the blocks of buildings are exact numbers of palms and must have been determined by the design of the elevations. Also the dimensions of the internal plans were dependent on the modulation of the façades and this determined the depth of buildings via well-defined rules of proportion. Also the position of the interior walls followed certain principles which relied on particular geometrical rules (see Section IV.2.3).

Influenced by the repetitive and standardised nature of the buildings, it has been suggested by many authors (2, 20, 37), but not adequately demonstrated, that prefabrication was employed as a central feature of the reconstruction programme.

This was in order to accelerate the reconstruction and alleviate the problems of scarcity of materials and shortage of specialised labour, allowing the production of a great number of pre-conceived elements (see Section IV.2.4). It has been demonstrated in the current work that certain measures were taken by the Authorities to encourage mass production and to avoid speculation, creating facilities for the production and transportation of materials and components and even creating stockpiles by the establishment of a "stock exchange", to guarantee the supply of these (see Section IV.2.4). A search has been made for contemporary documents relating to the rebuilding which would confirm the oral tradition about prefabrication but unfortunately many documents have been destroyed. However 13 buildings contracts have been found, and two of them include specific mention of building materials and components including stone steps, windows sills and jambs with dimensions in palms (see Appendix 4.5.iii and iv).

Observation in situ by the author does not reveal manufacturer's marks or signs for assembly but there does exist evidence that the components were conceived to adapt to any buildings. The production methods used at that time for the manufacture of components must have been inaccurate in both the external and internal layout. This is confirmed by the observation by the author of substantial manufacturing tolerances built into the design of some components. This allowed for a wide variability in dimensions. Thus for satisfactory assembly on site, the components were designed in such a way that they could be adjusted to fit spaces with varying dimensions or forms (see Section IV.2.4.). For example, in the fitting of doors use was made of packing pieces to accommodate inaccuracies of construction of the gaiola and to adapt the doors in height, width and thickness. This provides a strong indication that some components were prefabricated and mass-produced (see Section IV.2.4).The joints were also conceived in such a way as to conceal any imperfection or to close off a composition easily without the need for special tools (see Section IV.2.4).

The façade components appear to be a simplification and modulation of those of an already existing building, the Ludovice Palace in Lisbon, such that they could be adapted to rational mass production. Other elements of the compositions of the façades clearly derived from other existing buildings of the period. For example, the cornerstones, frontons, balcony windows, brick vaults and stone staircases were common in homes of the nobility at that time (see Section I.9). A detailed study revealed that traditional components such as railings were, in order to be standardized, simplified to give uniformity of components, with stylized decoration to provide modulation (see Section IV.2.4). The designs selected were ones which offered the maximum flexibility and adaptability to different dimensional and

functional situations, with repeat patterns offering great versatility and allowing interchangeability. Components were chosen with an eye to function, without any embellishment, with great solidity and which allowed simple repeated composition. This suggests that the components were conceived to be produced in an anonymous and abstract way by craftsmen, remote from the workers who would assemble them.

Clearly the mentors of the Pombaline quarter did not achieve the extent of dimensional coordination current in some buildings of the twentieth century. The extent of prefabrication in the Pombaline buildings is not as great, and they included, for example, substantial amounts of rubble stone walling. However they did incorporate many standardised and possibly prefabricated components, especially dressed stone and joinery items, the use of which relied on effective dimensional co-ordination and mass-production and supply from stock when required (see Section IV.2.4). The components did not differ radically from those which were already produced by craftsmen to order, which can be seen in surviving buildings from before the earthquake, such as Ludovice House. They were merely simplified, standardised and designed with tolerances to allow adaptation and to accelerate their manufacture, by mass production and assembly on site. They could then have been produced in an anonymous and abstract way in workshops scattered throughout the outskirts of the city as well as the interior.

VII.3. Classification of the diversity of internal plan.

If many of the technical innovations were imposed right at the start, there were other innovations that appear to have been developed and refined during the long period of the reconstruction. This is evident in the internal plans which although restricted by the modulation of the spaces in the façades, and the standardized dimensions of the components (like doors or the cage struts)(see page 143) showed a high degree of variability. There were no two plans alike, although there were building lots that were the same. Also the great variety of the interior plans does not bear any relation to the orientation, location, or size of the property or to the composition of the external façade (see Section III.2).

The author has identified and classified 12 different types of internal plan based on the distribution of spaces with reference to the location of the stairs in the buildings. Some of them were similar to previous medieval buildings in Lisbon and others to more modern buildings which suggested the existence of an evolution (see

Section V.2). The suggested evolution is in 3 principal phases and represents the movement of the stairs from the front of the building to the rear and then later to the centre. In the earliest proposed internal plan, type 1, in order not to divide the shop, the stairs climb behind the street facade, reaching the first floor in a single flight. The single flight created the inconvenience of alternate plans for different floors with some entrances far from the kitchen. This was solved in type 2A with the use of dogleg stairs but then the synchrony of stairs with the openings of the façades was lost. In type 3, the use of a third dogleg staircase, made possible the synchrony of the stairs with the façades and simultaneously provided the entrance near to the kitchen, but this was an expensive solution. In the proposed phase 2, beginning with type 4, stairs start to be located at the rear of the building from the first floor up, and in type 5, they were completely located at the rear behind the *alfugere* façade the openings of which could be synchronized because they did not need to be aligned. From type 6 to type 8 the stairs were brought slightly to the centre of the building in order to make use of a space behind the stairs to provide natural light. In phase 3, from type 9, there is the introduction of a glass skylight and the abandonment of stairs which climb alongside a wall or a "solid" balustrade. There was also the adoption of more complex open newel stairs, which made it possible to locate the stairs in the centre of the building and illuminate them with natural light. The complexity of the details associated with the proposed three phases did not change in a gradual way, and sometimes the finishes were of poorer quality in the proposed later phases (see Section V.3). An attempt was made to confirm the suggested evolution based on a documentary search to establish the dates of buildings but it was found impossible to determine precise dates for individual buildings. However a survey of tax records was undertaken in the Archives of Tribunal de Contas, which although not revealing the dates of individual buildings, gave the number of buildings completed on different streets at different periods (see Section V.4 and Appendix 4.1). Comparing this information with the distribution of the proposed phases amongst the buildings on different streets suggested that the proposed phases do not represent an evolution in the form of internal plan (see Section V.4). However the comparison does suggest a trend towards stairs in the middle in later buildings with a great abundance of stairs at the rear in earlier buildings. The wide variety of internal plan is attributed principally to client demand with different clients having different preferences for their accommodation, related to its perceived function, the client lifestyles and the levels of their wealth.

VII.4. The Pombaline area and other developments.

As a result of the great reforms inspired by the Enlightenment, during the eighteenth century numerous urban centres were built throughout Europe. Some examples are Bath, Edinburgh and Amsterdam(46).

In Portugal the phenomenon cannot be seen as an isolated development that only occurred in Lisbon as it was reflected all over the country as a response to the economic and administrative reforms that Pombal wished to impose. In Lisbon, where construction was dominated by the immediate need to reconstruct a city destroyed by an earthquake, the Pombaline quarter is characterised by extreme repetitiveness, uniformity of building height and elevation and a completely orthogonal plan. However in the other three contemporary developments studied in this work, although they contain elements of the Pombaline building they all have greater variety, giving them a character which could be described more as "Baroque", as opposed to the "Classicism" of the Pombaline quarter.

This was not the architecture of outstanding buildings, but the type of architecture which is born under the sign of urbanism, where the fundamental typology was the rentable building, with a commercial ground level and residential floors above, similar to those existing in Turin (44). It was a period in which churches were considered to be of little or no importance when compared with the preceding period.

The Pombaline rentable building appeared at a time of affirmation of administrative and political power and this is demonstrated in the construction of the new developments. The reconstruction of the city of Lisbon by the "Enlightened" regime of Pombal is an interesting case, not only because of its size but due to the fact that the reconstruction had been precipitated as a result of a severe earthquake, which had destroyed the original city centre.

In Vila Real and Porto Covo, the "Baroque" character is achieved through the punctuation of the residential blocks by "tower" buildings, and in Vila Real, by the contrast between parapets and eaves in the single storey houses, and the variety of form given by the arcaded salting houses (see Section VI.1.3 and VI.1.4). In Manique do Intendente, the "Baroque" character is generated by the use of the hexagonal central space and trapezium shaped blocks (see Section VI.1.5).

The strict adherence to both earthquake and fire precautions in the Pombaline quarter of Lisbon diminished outside Lisbon and the presence of anti-seismic measures was only observed in Vila Real (see Section VI.1.3). By the time Porto Covo and Manique do Intendente were planned, such measures were omitted, although

possibly this can be attributed to their smaller scale (see Section VI.1.4 and VI.1.5).

At the same time, the variety of internal layouts apparent in the Lisbon and Vila Real developments gave way to repetition in Porto Covo and Manique do Intendente, perhaps because the latter were small developments belonging to one particular entity, whereas the buildings in Vila Real were built by or for a number of individual owners, promoted by the regime.

Perhaps the most lasting influence of the Pombaline quarter of Lisbon was the development of dimensionally co-ordinated internal layouts, frequently with staircases serving two flats on each floor, the rooms of each flat being accessed independently from corridors or hallways. This contrasts with the previous medieval form of arrangement with staircases serving a single flat on each floor, and with interconnecting rooms within each flat.

In the Pombaline Area the most important rooms (dining and living rooms) were well-lit and airy and always faced the street. The kitchens always faced the interior space of the blocks and the unlit rooms, not existing in the other developments, were located in the middle and occupied about 18.5% of the habitable area.

VII.5. The contribution of the Pombaline rentable buildings to Portuguese architecture.

The destruction of a part of the original city by the 1755 earthquake disaster presented a unique combination of circumstances. There was a need for precautions to prevent a repetition of the disaster, and a desire for a rational, regular urban plan in keeping with the Enlightened thinking of the time and the military training of the engineers and architects who were thought to be most able to deal with the emergency which presented itself.

Due to the need to rebuild quickly and to ensure adequate production of components the construction was standardized allowing maximum prefabrication of components. The resulting Pombaline architecture identified by its stylizing, systematizing and homogenizing of the pre-existing elements in a rational way, produced an elegance of its own which is probably unique for that period, conforming to the simple, regular external appearance that was expected in the Age of Enlightenment. The end result was a combination of a totally rational urban plan with extremely repetitive, austere and individually unremarkable façades and a unique and rigorously regulated

construction system, together with internal plans of great variety in layout design, decoration and detailing. The precautions to prevent a repetition of the disaster included an anti-seismic construction system, wide and straight streets to facilitate quick escape to the safety of the squares, and the absence of external features or ornament which might fall on escaping residents or impede their escape in the event of emergency.

The architects and engineers with their military background, removed from an explicitly artistic environment, opted for a neo-classical style, more out of functional necessity than theoretical choice. They produced an innovative, simple, repetitive, cheap and standardized style of architecture with neo-classical tendencies, marking an important change to the panorama of Portuguese Architecture (36,40).

In the Pombaline area the rentable buildings were predominant with no place for palaces and with churches adopting the appearance and dimensions of the rentable buildings. From outside, the buildings appear not as individual entities but as blocks defined by continous austere façades rigidily imposed, with the only variations being in small details according to the hierarchy or relative importance of streets. These different types of façades form a hierarchy system in which six types have been identified each one with its specific design. The composition varies in accordance with the streets with perfect alignment of the masonry both horizontally and vertically. The design of the facades in the principal streets is rather more elaborate (see Section III.1).

In complete contrast with the regulated, repetitive external facades, the interior layout of each building was individually designed to the requirements of the building owner and occupants, and as discussed previously there appears to have been a shift in preference as time went on, from a rear to a central staircase and from a " medieval" to a "modern" plan (see Section V.4). This shift in preference took place without any change at all in the external treatment and with only minor and unrelated changes in the construction system.

This wide variation in internal layout, associated with purpose-designing and purpose-building for individual clients, contrasts with the standardised, repeated internal layouts characteristic of, for example, eighteenth century speculative terraced housing in Bath and Edinburgh. Although elements of the Pombaline buildings are present in other contemporary developments outside Lisbon the peculiar combination of all elements which characterise them is unique to Lisbon. These elements are the following. The buildings, with one commercial floor and three upper residential floors, were always grouped in blocks with repetitive modulated

façades with openings aligned vertically and horizontally, characterized by a great simplicity and repetition. The hierarchy of buildings is established only through the variation of minor details. Technical innovations against earthquakes are incorporated in the form of an anti-seismic structure. The interior has a great diversity, the plans are different from one building to another. There is no relationship between the exterior types (related to the location of buildings), and the interiors.

The Pombaline phenomenon holds a major lesson for architects today - that standardisation, prefabrication, and a uniform external public facade can coexist with individually designed, infinitely variable interiors, and that a static, regulated external façade design, repeated in different buildings over a period of time can coexist with internal layouts varying with time over many decades.

Near to the 300th anniversary of the birth of the Marquis of Pombal much of the area built under his direction still exists today, standing as a monument to him and to the Engineers such as Manuel da Maia who organized the buildings process and the Architects Eugénio dos Santos and Carlos Mardel, who planned and supervised the work. This is in contrast to what has happened to many European cities which were destroyed during the Second World War.

VII.6. Recommendations for future development of the work.

Due to the complexity, vastness and importance of the Pombaline area many aspects still need to be investigated. Owing to the extensive nature of the subject under study in this work the author was unable to study in depth many of the aspects observed. The following are therefore suggested as fruitful areas of further study:

i.The innovations brought about by the Pombaline rentable buildings of Lisbon, the development of the anti-seismic wooden structure, the standardization of components, the standardization of the elevations of buildings on such a large scale and their adaptation to different and innovative internal layouts, is in itself totally unique for the eighteenth century, and surely deserves immediate protection and international recognition possibly as a World Heritage Site. So it is necessary to begin the complex process of further study to achieve this objective.

ii. The study of most of the construction details was limited to the analysis of the buildings which have been destroyed over the past ten years, numbering nineteen. From the observations of these buildings the author was able to conclude that no two buildings are exactly alike in their construction and whilst on the one hand, there

were general construction principles common to groups of buildings, there were also some elements peculiar to particular buildings. It is therefore necessary to record additional construction details during any future destruction or substantial alteration of further buildings in order to understand these variations. There are also some finishings, for example the tile dados created expressly for the decoration of particular buildings, which due to their high commercial prices are being systematically removed, which should be recorded in detail.

iii. A much greater in depth study of the behaviour of the "cage" structure is required. During the research period, the author did not have the technical and financial means at his disposal to collect and test samples of parts of buildings in the laboratory or to conduct "in situ" field tests to determine the loads to which the external walls are subjected as well as their field stress and to determine the deformation of floors and walls subject to loads in the interior of the living rooms at the different levels, so as to gain a better understanding of their behaviour during an earthquake.

iv. A careful physical and chemical analysis of samples of stone and wood used in the structure or in the finishings may reveal their type and origin. This could provide information on the number of suppliers and their location.

v. During the Pombal regime building was also carried out as part of an expansion of the city of Oporto. There are existing studies of the urban and architectural aspects of this development, however little is known about the construction details of the buildings which were erected. The construction was in a stable zone in seismic terms and with abundant materials and human resources and therefore the result could show marked contrasts with the Pombaline development in Lisbon. Also during the Pombaline period and after, numerous cities in the Portuguese colony in Brazil developed rapidly and it would be interesting to study how cities and buildings were conceived there, especially during the period of the French invasions in 1806-1812 when the Portuguese government was transferred to Brazil. It might be expected that the massive rebuilding programme, initiated in the capital city of Portugal after such a devastating earthquake, would have repercussions that would be felt beyond the confines of the city of Lisbon. It would be interesting to know how buildings evolved later in these other regions outside the Pombaline area.

Bibliography

(1) Smith, J. E. S. Q., "Memoirs of Marquis of Pombal", vol.I, Longman, London, (1843).

(2) França, José-Augusto,"Lisboa Pombalina e o Iluminismo", Bertrand Editora, Lisboa, (Dec. 1983).

(3) Gerard Pradalié, "Lisboa da Reconquista ao fim do séc. XII", 1st edition, Lisboa, (1975).

(4) Jorge Segurado, "Lisboa no Passado e no Presente", Edições Excelsior, Lisboa, (1971).

(5) Vieira da Silva, Augusto,"Dispersos", Biblioteca de Estudos Olisiponenses, Lisboa, (1960).

(6) Oliveira Martins, J. P., "História de Portugal", Imprensa Nacional-Casa da Moeda, (Lisboa 1985).

(7) Sequeira, Gustavo Matos, "Lisboa oito séculos de História", vol I, "D. Dinis - A Cidade Medieval", Câmara Municipal de Lisboa, Publicações comemorativas do "Oitavo Centenário da Tomada de Lisboa aos Mouros, Lisboa, (1947).

(8)"História de Portugal", Edição Monumental da Portucalense Editora, Vol.II, Barcelos, (1929).

(9) "Grande Enciclopédia Portuguesa e Brasileira", vol.15, Editora Enciclopédia Limitada, Lisboa e Rio de Janeiro, (1945).

(10) "Lisboa, Revista Municipal", ano 48, nº22, Edição da Câmara Municipal de Lisboa, (4º Trimestre de 1987).

(11) Ribeiro, Mário de Sampayo, "Lisboa oito séculos de História", vol I, "*Lisboa Manuelina*", Câmara Municipal de Lisboa, Publicações comemorativas do "Oitavo Centenário da Tomada de Lisboa aos Mouros, Lisboa, (1947).

(12) Queiroz Veloso, "Lisboa oito séculos de História", vol I, "*Na Era da Renascença*", Câmara Municipal de Lisboa, Publicações comemorativas do "Oitavo Centenário da Tomada de Lisboa aos Mouros, Lisboa, (1947).

(13) Gastão de Melo Matos, "Lisboa oito séculos de História", vol I, "*Lisboa na Restauração*", Câmara Municipal de Lisboa, Publicações comemorativas do "Oitavo Centenário da Tomada de Lisboa aos Mouros, Lisboa, (1947).

(14) Silva Dias, J.S., "Pombalino e Teoria Política", Cultura História e Filosofia, Coimbra, (1982).

(15) Pires, António Caldeira, "História do Palácio Nacional de Queluz", Coimbra (1925).

(16)Macedo, Luís Pastor," A Baixa Pombalina", ed. Grupo de Amigos de Lisboa, Lisboa, (1938).

(17)"The Lisbon earthquake of 1755-British Accounts", The British Historical Society of Portugal, Lisótima edições, Lisboa (1990).

(18) "Património Arquitectónico e Arqueológico Classificado", IPPAR, Secretaria de Estado da Cultura, Lisboa, (1993).

(19) Joaquim Veríssimo Serrão, "O Marques de Pombal", o Homem, o Diplomata e o Estadista, Sociedade Industrial Gráfica, Lisboa, (1982).

(20) França, José-Augusto, "A reconstrução de Lisboa e a Arquitectura Pombalina", Biblioteca Breve, vol.12, 3ª edição, Instituto de Cultura e Língua Portuguesa, Ministério da Educação, Lisboa (1989).

(21) Exposição "Lisboa e o Marquês de Pombal", vol. I and II, Museu da Cidade, C.M.L., Publicidade e Artes Gráficas, Lda., Cruz Quebrada (1982).

(22)"Enciclopédia Histórica de Portugal", Vol.X, p.273, Pombal, Lisboa (1960).

(23) Matos Sequeira, Gustavo, "Depois do Terramoto", vol. IV, Lisboa (1933).

(24) Meneses, Carlos José, "Os Jesuítas e o Marques de Pombal", Edition José Maria Simões, Porto, (1893).

(25) Coelho, J. M. Latino, "O Marquês de Pombal", Ed. Popular, Lisbon, (1905).

(26) Oliveira e Sousa, João Saldanha, "A execução da Marqueza de Távora", Oficina Graficas da C. M. L., Lisbon, (1938).

(27) Rebello da Silva, "História de Portugal nos Sec. XVII e XVIII", Imprensa Nacional, Lisboa, (1971).

(28) História de Portugal, O Antigo Regime, Editorial Estampa, Lisboa, (1993).

(29) It seemed that the Jesuits encouraged the Indians in Brazil to resist the expansion of the "Companhias of Grão-Pará, Maranhão, Pernambuco, etc.", and the application of the "Madrid Treaty".
See the film "The Mission", Int. Robert de Niro, Jeremy Irons, Ray Mcannally, Lian Neeson, Prod. David Putnam, Fernando Ghia/ Goldrest/ Kinesmere, Enigma (1984).

(30) José Nunes Curado, "Construção Anti-Sismica no Sec.XVIII", in Diário de Noticias, 8th October, Lisboa, (1994).

(31) Livro IV das "Intendências do Ministério da Justiça", Decreto 15/5/1756, Arquivo Nacional da Torre do Tombo.

(32) João Manuel Mimoso, "Geometria dos batentes Pombalinos", 2º Encore, Encontro Sobre Conservação e Reabilitação de Edifícios, LNEC, Lisboa, (1994).

(33) Piedade Braga Santos, Teresa S. Rodrigues, Margarida Sá Nogueira, "Lisboa Setecentista, Vista por estrangeiros", Ed. Livros Horizonte, Lisboa (1987).

(34) George Kulber, "A Arquitectura Portuguesa Chã"", Assírio e Bacelar, n. date.

(35) José Eduardo Horta Correia, "Arquitectura Portuguesa", Estilo Chão, Editorial Presença, Lisboa (1991).

(36) Pardal Monteiro, "Eugénio dos Santos, Perçursor do Urbanismo e da Arquitectura Moderna", in Museu, V, n. 11, Porto, (1949).

(37) Moreira, Margarida Paula Pinto Cardoso, "Conservation of an historic Urban Centre, A study of a Downtown Pombaline Lisbon", PhD Thesis, University of York, 1993, not published.

(38) "O Mundo de Cá", Episodes "Passo de Benastarim" and "O dente de Buda", Prod. R.T.P., Comissão Nacional para as Comemorações dos descobrimentos Portugueses e Fundação Oriente, 29.10 and 5.11 of 1995.

(39) José Luiz Menezes, Maria do Rosário Rodrigues, "Fortificações Portuguesas no Nordeste do Brasil, Séculos XVI, XVII E XVIII", Editorial Pool, Recife, (1986).

(40) Pardal Monteiro, "Os Portugueses Precursores da Arquitectura Moderna e do Urbanismo", in Museu, II, Porto, 1949.

(41) Christian Norberg-Schulz, "History of World Architecture, Baroque Architecture", Harry N. Abrams, Inc. Publishers, Pier Luigi Nervi Harry N. Abrams,N. York, n. date.

(42) A. E. J. Morris, "History of Urban Form, Before the Industrial Revolution", 3rd edition, Logman, Scientific & Technical, New York, (1994).

(43) Edmund N. Bacon, "Design of Cities", Thames and Hudson, London (1967).

(44) Sir Banister Fletcher's, "A History of Architecture", 19th edition, Edition John Musgrove, Butterworths, London, (1987).

(45) Maria Luísa Mandonna, "Os modelos urbanísticos iluministas em Espanha", "Coloquio Lisboa Iluminista e o Seu Tempo, Universidade Autónoma de Lisboa", Lisbon 1994, not published.

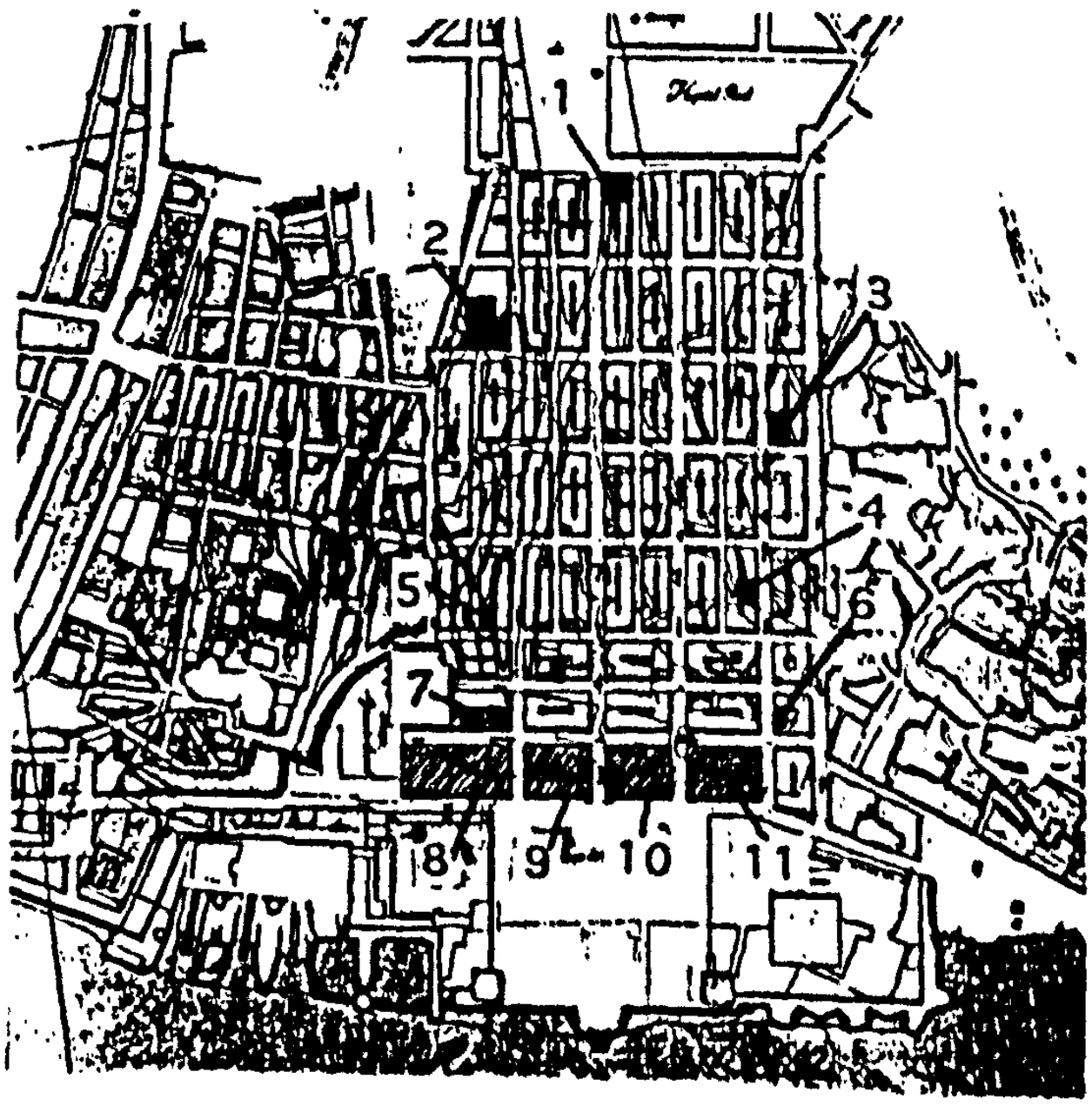
(46) José Eduardo Capa Horta Correia, "Vila Real de Santo António, Urbanismo e poder na política Pombalina", vol. I, II and III, PhD dissertation, Universidade Nova de Lisboa, Lisboa (1984).

(47) "Décima da cidade de Lisboa e o seu termo 1760-1840", (Register of tax collection) Arquivo Histórico do Tribunal de Contas, serial volumes 0302 (streets), Lisbon, not published.

(48) Fires registered in the pombaline area mentioned in Macedo, Luís Pastor, "A baixa Pombalina", ed. Grupo de Amigos de Lisboa, Lisboa, (1938).

1. 29.12.1886
2. 12.01.1805
3. 24.06.1937 (n.234)
4. 1.9.1873
5. 1858
6. 9.5.1905
7. Bank of Portugal 4.10.1816
8. 19.11.1863 Public offices and the Municipality
9. 10.06.1821 Public offices and archives
10. 11.05.1863 Public offices
11. 3.01.1830 and again in 13.06.1782

Fires 8, 9 and 10 affected archives with information of buildings in Lisbon.



(49) Brazão Farinha, comunication on "Simpósio Sobre Acção dos Sismos", Lisbon, (1958).

(50) Cruz, Helena, "Caracterização mecânica das madeiras", Encontro sobre a revitalização e reabilitação da Baixa Pombalina, Ordem dos Engenheiros da Região Sul, Lisbon, 1994, not publish.

(51) V. Coia e Silva, "Apoio à modelação estrutural por métodos não destrutivos de paredes de travamento dos edfícios "em gaiola" da Baixa Pombalina", "2° Encore, Encontro Sobre Conservação e Reabilitação de Edifícios", LNEC: Lisbon, (1994).

(52) José Victor Gomes, "A modelação matemática na análise estrutural da Baixa Pombalina", "2° Encore, Encontro Sobre Conservação e Reabilitação de Edifícios", LNEC: Lisbon, (1994).

(53) Santos, Pompeu, "Caracterização mecânica das paredes de alvenaria simples e de gaiola", "Encontro sobre a revitalização e reabilitação da Baixa Pombalina", Ordem dos Engenheiros da Região Sul e C. M. L., Lisbon, 1994, not publish.

(54)-Notarial documents, in the Archives of Torre do Tombo
Notary Tavares de Carvalho, (Cartório 4)
Building contracts:
Between Giraldo Roiz da Fonseca and Filipe Caetano, Livro 8, May 1760
Between João Batista Terrabuse and Jacinto Pereira, Livro 9, January 1761
Between Francisco António Vasconcelos and Luis da Cunha e Castro, Livro 10, June1761
Between António vieira and Manuel António Sousa, Livro 18, February 1766
Between Francisco da Fonseca Soares and Affonso Sa..., Livro 18, May 1766
Notary Eugénio Carvalho e Silva
Building contracts:
Between Manuel de Sousa and Mateus Luís, Livro 12, June 1759
Between José Manuel Fonseca and Joaquim Simão Dias, Livro 12, June 1759
Between Dom Henrique da Silva and others , Livro 34, March 1771
Between Dom José Antonio Bargueti and others, Livro 46, March 1776
Between Cipriano Joaquim António and others, Livro 47, August 1776
Between (?), n°13, Livro 49, April 1777

(55) Contract number 6
"Indice das escrituras de Outubro de 1757 até Janeiro de 1790", Notário Tavares de Carvalho, Livro 8, Caixa 2, Number 91, August 1760, Arquivo Nacional da Torre do Tombo, Lisbon, not published.

(56) Contract number 4
"Indice das escrituras de Outubro de 1757 até Janeiro de 1790", Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, Number 55, May 1776, Arquivo Nacional da Torre do Tombo, Lisbon, not published.

(57) J. Gorani, "A Corte e o Pais nos anos de 1765 a 1767", Lisboa 1945 and W. Dalrymple, "Travels throught several provinces of Spain and Portugal", London (1779).

(58) Monteiro de Carvalho, José, "Relação de propriedades edificadas entre 1755 e 1778", manuscrito, Arquivo da Câmara Municipal de Lisboa, not published.

(59)"Porto Côvo", Gabinete de Informação, Câmara Municipal de Sines, n. date.

(60) "Azambuja, Manique do Intendent", Pelouro do Turismo, Câmara Municipal da Azambuja, n. d..

(61) Margarida Calado, "Urbanismo e Poder no Portugal do Séc. XVIII. Tojal Vila Real de Santo António, Porto Côvo e Manique do Intendente", "Coloquio Lisboa Iluminista e o seu Tempo, Universidade Autónoma de Lisboa", Lisbon 1994, not published.

(62) "Arquitectura Popular Portuguesa", Porto Côvo, 3rd edition, vol.3, Associação dos Arquitectos Portugueses, Lisboa, (1988).

(63) Peter Smith, "Houses of the Welsh Countryside", Her Majesty´s Stationery Office, London, 1988.

ILLUSTRATIONS REFERENCES

(Front)
Pombaline area
Postcard, (photograph), n. ass.; n. dat., Ed. Collection Dulia.

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E. Santos Poppe, Plan Number 6, partial copy from: Augusto-França, José, "Lisboa Pombalina e o Iluminismo", 3th edition, p.26, Bertrand Editora, Lisbon, 1983.
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Photograph, n. ass.; n. dat., Col. Biblioteca Nacional de Lisboa, Secção de estampas, M. R. Simões, Lisbon

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The illustrations of the brief summary of the History of Portugal were adapted expressly for this work from:
História de Portugal, António Feio, José Oliveira Cosme, Carlos Alberto, Agência Portuguesa de Revistas, Lisbon, Set. 1965

Fig.3-An old iconographic reference, n. ass.; n. dat.
Copy from:
José Lobo de Carvalho, Castle Hill in Lisbon, The Centre for Advanced Architectural Studies, York University, York 1983

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Copy from:
José Lobo de Carvalho, Castle Hill in Lisbon, The Centre for Advanced Architectural Studies, York University, York (1983), Not published.

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Copy from:
Exposição - Lisboa Quinhentista, Col. 1, pag 32, Museu da Cidade, C.M.L., Imprensa Municipal de Lisboa , Lisbon 1983

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Luis Pereira de Sousa, Terramoto do 1º Novembro de 1755 em Portugal, Lisboa 1923, Serviços Cartográficos da École Pratique de Hautes Études de Paris
Published in:
José-Augusto França, Lisboa Pombalina e o Iluminismo, Terceira edição, p.63, Bertrand Editora, Lisboa 1983

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Copy from:
José-Augusto França, Lisboa Pombalina e o Iluminismo, Terceira edição, p.68, Bertrand Editora, Lisboa 1983

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Revisão crítica de conceitos básicos sobre sismologia, Lessons, Universidade de Ciências de Lisboa., p.66, Fig-12

Fig.26-Jõao Nunes Tinoco, 1650
Copy from:
José-Augusto França, Lisboa Pombalina e o Iluminismo, Terceira edição, p.26, Bertrand Editora, Lisboa 1983

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José-Augusto França, A reconstrução de Lisboa e a Arquitectura Pombalina, Plate 7, Biblioteca Breve/ vol.12, 3ª edição, Instituto de Cultura e Língua Portuguesa, Ministério da Educação, Lisboa1989

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Parcial copy from:
O terramoto de 1755-Testemunhos Britânicos, Anthology of accounts of the XVIIIth century., p.104, The British Historical Society of Portugal & Lisótima edições L.da, Lisbon 1990

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Copy from:
Serrão, Joaquim Veríssimo, O Marquês de Pombal, C.M. de Lisboa, Oeiras e Pombal, Soc. Industrial Gráfica; Lisbon 1982

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Copy from:
José-Augusto França, A reconstrução de Lisboa e a Arquitectura Pombalina, Plate 2, Biblioteca Breve/ vol.12, 3ª edição, Instituto de Cultura e Língua Portuguesa, Ministério da Educação, Lisboa1989

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Biblioteca Breve/ vol.12, 3ª edição, Instituto de Cultura e Língua Portuguesa, Ministério da Educação, Lisboa1989

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Fig.81-Illustration by author.
Based on example of Museu dos Bombeiros Sapadores de Lisboa.

Fig.82-Illustration by author.
Fountain in Lisbon, Janelas Verdes

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Fig.87-Illustration by author.

Fig.88-Illustration by author.

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Wilfried Koch, Estilos de Arquitectura I, Editorial Presença, Vila da Feira, 1985.

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110, S. Julião Street
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Fig.104-Eugénio dos Santos, n. dat., Arch. Câmara Municipal de Lisboa,
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Fig.106-Illustration by author.
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Fig.118-Illustration by author.

Fig.119-Illustration by author.
Arsenal Street

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Fig.221-Illustration by author.

Fig.222-Illustration by author.
56-60, Ouro Street

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Fig.264-Illustration by author.
75, Conceição Street, first floor

Fig.265-Illustration by author.
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75, Conceição Street, first floor

Fig.267-Illustration by author.
75, Conceição Street, first floor

Fig.268-Illustration by author.
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Fig.269-Illustration by author.
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Fig.270-Illustration by author.
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Fig.283-Configuração 6, Eugénio dos Santos, 1756, Arch. Câmara Municipal de Lisboa
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José Eduardo Horta Correa, Vila Real de Santo António, Urbanismo e Poder na Política Pombalina, vol.II. PhD dissertation, Universidade Nova de Lisboa, Lisbon 1984.

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Real Square (Marquês de Pombal Square)

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Main Square

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Fig.356-Illustration by author.

A STUDY OF THE DESIGN AND CONSTRUCTION OF BUILDINGS IN THE POMBALINE QUARTER OF LISBON.

VOL. II APPENDICES

A dissertation submitted by

Jorge Morarji Dias Mascarenhas

Licenciado em Arquitectura

Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy, (PhD), of the

UNIVERSITY OF GLAMORGAN

Department of Civil Engineering and Building,

Pontypridd, Mid Glamorgan, U.K..

Collaborating Establishment

Instituto Politécnico de Santarém

Escola Superior de Tecnologia e Gestão de Tomar

July 1996

DECLARATION

I declare that, this thesis is the result of my own studies, it has not been accepted for any other award or degree and is not concurrently being submitted in candidature for any other award or degree.

Signed:.....

Date:.....

Volume II APPENDICES

Appendix 1 - The original proposals for the reconstruction by Manuel da Maia and the Alvará De 12 De Maio De 1758

1.1 Dissertação De Manuel Da Maia
- i) Primeira Parte
- ii) Segunda Parte
- iii) Terceira Parte

1.2 Alvará De 12 De Maio De 1758

1.3 Interpretation by the Author of the Alvará De 12 De Maio De 1758, (Licence of the 12th May 1758).
- i) Guidelines for the redistribution of land for building
- ii) Indications of how to solve bureaucratic problems and to encourage construction

This appendix contains copies of Manuel da Maia´s dissertations, which are divided into three parts. The first part is about the decision that was to be taken regarding the location of the construction of the new city. The second part, written after it had been decided to construct on the same site, proposes various ways of renovating the old city or opting for a new plan. The third part proposes various plans for reconstruction as well as some innovations to prevent further calamities and improve the hygiene and safety conditions in the new development. The Alvara De 12 De Maio De 1758, licence of of May 12th, gives some indications as to how bureaucratic problems were to be solved and how to encourage construction.

The documents were written in archaic Portuguese making it difficult to read particularly with its constant repetitions. The dissertations were analysed in Chapter I.6. As for the licence of May 12th, the author interpreted and translated the main aspects, which included incentives for rapid construction and the process of redistribution of property from the old to the new urban grid.

The dissertations by Manuel da Maia were copied from:

França, José-Augusto, Lisboa Pombalina e o Iluminismo, 3rd edition, Ed. Bertrand, Lisbon 1983. The original documents are in the Livro IV das Intendencias do Ministério da Justiça, Arquivo Nacional da Torre do Tombo.

Appendix 1 - The original proposals for the reconstruction by Manuel da Maia and Alvará De 12 De Maio De 1758

1.1 Dissertação De Manuel Da Maia

i) Primeira Parte

1. — Reconhecida, e observada a destruição da cid.ª de Lix.ª he precizo intentar-se a sua renovação, e como esta se pode executar por diversos modos, parece tambem precizo que estes se preponderem p.ª entre elles se fazer eleição do q̃ se conhecer com mais ventagens, e menos inconvenientes. Os modos que me occorrem são os seguintes.

2. — O primr.º restituila ao seu antigo estado, levantando os edificios nas suas antigas alturas, e as ruas nas suas mesmas larguras. Este 1.º modo suppoem, q̃ o terremoto passado não he pronostico de outro; e que assim como em m.tos annos ant.es senão experimentou outro sem.º assim se não pode esperar subsequente: e q̃ por esta forma se restituirá Lix.ª promptissimam.te ao seu antigo estado, e com edif.os melhorados por novos; recebendo e acomodando o mesmo n.º de gente; e obtendo os proprietários os seus antigos rendim.tos ficando Lix.ª deste modo com algũa melhora q̃ dantes era; servindo os mesmos destroços, e ruinas p.ª a erecção dos edif.os evitando o trab.º e despeza dos dezentulhos; cuja acomodação se faz mui dificil, e talvez de prejuizo, onde os quizerem acomodar, ou seja no mar ou na terra.

3. — O 2.º modo, levantando os edificios nas suas antigas alturas, e mudando as ruas estreitas em ruas largas. Este 2.º modo tambem despreza a precaução do terremoto, e attende em pr.º logar a melhor serventia do publico pela largura das ruas, e conservando nas alturas as cazas abundantes commodos p.ª os habitadores, q̃ restarão livres de horrivel flagello, e p.ª os proprietarios a mayor p.te dos rendim.tos, ficando a cid.e mais formosa do q̃ d'antes era, com boas entradas, q̃ p.ª ella se poderão fazer no terr.º do Paço, evitandose passagens cobertas, e melhorandose alguns edificios mayores arruinados; ficando deste modo Lix.ª com conhecidas ventagens, e conservandose em m.ta p.te os interesses dos prejudicados nas ruinas, o q̃ não deixa de merecer attenção.

4. — O 3.º modo, diminuindo as alturas a dous pavim.tos sobre o terreo, e mudando as ruas estreitas em largas.

5. — Este 3.º modo se acautela contra sem.es assaltos, diminuindo as alturas dos edif.os por se temerem nos mais altos as ruinas mais certas, e de mayores prejuizos: como p.te contr.º nas ruas mais largas mayor facilid.e p.ª se escapar dos destroços, q̃ nas estreitas servẽ de grande impedim.to ao retiro.

6. — O 4.º modo, arrazando toda a cid.ª baixa, levantandoa com os entulhos, suavizando assim as subidas p.ª as p.tes altas, e fazendo descenso p.ª o mar com melhor correnteza das aguas, formando novas ruas com liberd.ª competente, tanto na largura, como na altura dos edif.os q̃ nunca poderá exceder a largura das ruas. Este 4.º modo não só attende, como o terceiro, a prevenção de se m.ª flagello, assim na observação da altura das cazas, como na largura das ruas, mas a faci litar a difficil acomodação dos dezentulhos, servindose delles p.ª suavizar a aspereza das serventias da cid.ª baixa p.ª a alta, e expelindo tambem as aguas com melhor exito p.ª o mar, livrando Lix.ª baixa das inundaçoens q̃ padece em occasioens de maré chea.

7. — O 5.º modo, desprezando Lix.ª arruinada, e formando outra de novo desde Alcantara até Pedrouços; com permissão porem de q̃ os donos das cazas de Lix.ª arruinada as podessẽ levantar como quizessem. Este 5.º modo se facilita mais q̃ todos; porq̃ em pr.º lugar não tem q̃ vencer dificuldad.es de dezentulhos, e suas acomodaçõens: offerece campo docil, e livre das emin.as de Lix.ª antiga, sem necessid.ª de averiguar o estado das cazas q̃ se devam conservar ou derribar, nem ouvir clamores dos donos das q̃ inteiram.te se desprezarem, e sobre tudo a grande despeza, q̃ na compensação destes prejuizos se fará por qualquer modo q̃ se pretenda fazer. Edificarse com mais gosto pelas melhoras que geralm.te se reconhecem no terreno e prayas do sitio de Bellem, e suas vizinhanças, livrando os habitadores do horror q̃ conceberão na destruição da cid.ª arruinada; e com incomparavel brevid.ª e boa organização de ruas e de edif.os q̃ formarã hũa Lix.ª nova, sem q̃ os dominantes dos edif.os de Lix.ª destruida tenhão de q̃ se queixar, pois se lhe não faz viol.ª algũa, nem se lhes impede a reedificação dos seus edif.os p.ª se valerem delles á sua vontade. Acrece mais, q̃ ainda q̃ se lanse mão de qualquer dos ant.es modos, 2.º, 3.º e 4.º em q̃ as ruas se alargão, sempre hade ser precizo estenderse Lix.ª até Bellem, ou ainda a mayor dist.ª p.ª acomodação da m.ta gente q̃ ficará necessitada de commodo por causa da diminuição das cazas; pois q̃ as de quatro e sinco pavim.tos ficarão convertidas som.te em dous; e em hũ sitio em q̃ havia quatro ou 5 ruas, ou mais, se converterão em duas ou 3 ao m.to: e se depois de vencer m.tas dificuld.es com grandissimo trabalho, dispendio, e dilação de tempo, se hade procurar o asylo de Bellem, melhor parecia buscarse logo p.ª mayor facilid.ª satisfação do publico, e escuza de despeza. Tambem a sumersão do novo caes da Alfandega do tabaco, parece estar aconselhando q̃ se não avezinhem a hum lugar q̃ mostra estar combalido de contr.º fortissimo, q̃ poderá continuar em o perseguir, e a tudo q̃ o acompanhar. Tambem parece favorecer esta opinião o acharemse em Portugal algũas cid.es e povoaçoens q̃ conservão os nomes de outras destruidas, cujas ruinas se percebem ainda em dist.as proximas, sem se especificar a razão daquella repetição de nomes, e de lugares; mas discorrendo qual poderia ser, nenhũa razão me ocorre mais propria e competente p.ª este feito do q̃ outra sem.ª a q̃ temos diante dos olhos, fazendo antes eleição de formar hũa cid.ª e povoação nova em sitio mais favoravel, do q̃ renovar hũa destruida por sem.ª accidente. Tambem pode fazer pezo nesta eleição a observação de ser mais violento e eficaz o efeito do terremoto na p.te mais repleta de habitantes cujos excretos, penetrando e permeando mais os poros da terra, possão concorrer com mayor adjutorio p.ª a formatura do terremoto, ou atrair a si os seus efeitos com mais sem.ª e abund.ª simili. O q̃ podendo ser assim tambem aviza, q̃ se evite q.to for possivel a continuação de hum tal atractivo. Persuado-me ter lido q̃ já Lix.ª padeceo perseguição de terremotos por tempo de um

anno; e como o fogo me consumiu todo o adjutorio de q̃ me valia p.ª narrar com segurança, não poderei determinar o tempo nem o vigor de seu principio, nem algũas mais especialid.es que occorrerão; mas sempre pode servir de exemplo, de q̃. a communicação dos taes excretos possa servir de alim.to p.ª sem.e destroço. A multiplicidade de terremotos, que tem padecido Constantinopla cid.e populosissima parece corroborar esta supposição: *quae sola non profunt, multa colletta juvant.*

8. — Atéqui o q̃ me occorreo dizer a favor de cada hum dos sinco modos possiveis p.ª a renovação de Lix.ª; restame declarar o q̃ se poderá dizer em contr. p.ª ver se com estas ponderaçoens me poderei determinar a tomar algum partido em forma q̃ se não possa dizer q̃ o fiz sem estas antecedencias.

9. — No 1.º modo encontro a falta de atenção ao melhoram.to de hua cid.e que se edifica de novo conservandolhe as ruas estreitas, o q̃ as fas de aborrecivel uzo, e as cazas m.to altas com o horror que das suas alturas se tem concebido; não obstante poderse dizer, q̃ este horror hade ser de pouca duração, porq̃ em fazendo algũa pessoa veneranda edif.º de mayor altura de dous pav.tos logo outras de qualquer veneração a irão imitando, e consequentem.te todas as q̃ tiverem com q̃ o fazer; porq̃ ao mesmo passo q̃ vai esquecendo o horror do terremoto, se irá esquecendo o da ley dos dous pavim.tos. Sirva de exemplo a ley do alinham.to p.ª q̃ as cazas se renovassem, e recolhessem até q̃ as ruas ficassem em certa largura, como a da rua dir.ta das portas de S. C.na onde se executou athé certo tempo, e se não continuou em algũa das cazas q̃ depois se renovarão ou se edificarão de novo.

10. — O 2.º modo, ainda q̃ attende á formosura da cid.e p.to q̃ toca a largura das ruas, tem o defeito de se não acautelar contra o flagello dos terremotos nas alturas dos edificios; e posto q̃ favorece aos donos dos edif.os restantes em lhes conservar o n.º dos moradores, e consequentem.e os rendimentos, e tambem possão dizer q̃ a ley dos dous pavim.tos terá o mesmo efeito q̃ a ley do alinham.to, não são razoens subsistentes por dependerem do futuro.

11. — O 3.º modo q̃ parece mais admissivel, porq̃ attende assim a formosura da cid.e no espaçozo das ruas, e precaução dos terremotos nos dous pavim.tos só permitidos, tem contra si os clamores dos donos dos edif.os extinctos, e outros diminutos de rendim.tos pela diminuição dos inquilinos, entre cujos clamores, serão m.to distintos os dos Morgados, Eccles.os e Irm.dos que costumão ser m.to attendidos; como tambem tem contra si a acomodação dos dezentulhos, porq̃ alem dos q̃ se achão já occupando as ruas largas e estreitas, hade acrecer o de todas as casas q̃ se hão de extinguir inteiram.te e mais q̃ tudo a gravissima despeza com q̃ se hade substituir a diminuição dos edificios extinctos ou em p.te ou em todo.

12. — O 4.º modo, posto q̃ vence ao 3.º em evitar o embaraço dos dezentulhos, e em dar melhor serventia á cid.e, sempre fica com o grave pezo de dar a cada hum a justa satisfação do q̃ lhe pertencer.

13. — O 5.º modo, q̃ parece o mais facilitado, não deixará de ter contra si o interesse dos donos das casas edificadas nas ruas principaes de Lix.ª, receando q̃ se lhes diminuão o rendimento dos seus alugueis, aumentandose m.to o n.º das habitaçoens em p.tes de differente eleição.

14. — O q̃ assim ponderado, resta fazer escolha de algum dos sinco modos de q̃ se não possa seguir arrependim.to, no q̃ encontro grande dificuldade, e p.ª poder sair della,

me tem occorrido, q̃ só a eleição q̃ S. Mag.e fizer do sitio p.a o seu Real Palacio poderá fazer pezar a opinião q̃ lhe for mais apropriada; porq̃ se S. Mg.e for servido querer o seu novo e real Palacio no sitio de Bellem, fica o modo n.o 5.o infalivelmente adoptado e preferido a todos os outros; porem se S. Mag.e fôr servido querer lançar mão de hum sitio salutifero, e superior apropriado p.a cabeça de Corte com boas 4 communicações p.a a cid.e e p.a o campo, aproveitando-se prim.am.te do beneficio da agua livre de Bellas, e terreno firme e solido com bom livelam.to e capacidade p.a edificar com grandeza, he este o sitio entre S. João dos Bemcasados e o conv.to de N. Sr.a da Estrella com 4 communicaçoens de bom uso; a 1.a p.a o campo, interior do paiz por Campolide, e Sete rios: a 2.a pelo Rato, Noviciado da Cotovia etc: a 3.a p.la rua nova de S. Bento, ou nova colonia: a 4 p.lo cam.o do S.r da boa Morte, Fonte Santa, N. Sr.a das Necessidades etc. até o mar, caminhos todos de bom livelam.to e correntezas de aguas p.a limpeza dos edif.os e ruas depois de terem servido nas fontes e tanques do Real Palacio, e de hum Hospital na quebrada da cerca de S. Bento p.a a p.te do nascente, cuja pozição já escolhi q.do se tratou do sitio p.a o Hospital real de todos os Santos, por o reconhecer melhor no prez.te tempo do q̃ o de junto a S. D.os no rocio. Tambem não posso deixar de lembrar q̃ no tal novo e real Palacio se poderá formar hũa Biblioteca publica por evitar o justo reparo de a não haver na Corte de Portugal, e junto a ella a casa do Real Archivo, q̃ ainda q̃ o terremoto o não destruisse, sempre necessitava de hũa tal acomodação á imitação do Archivo Romano, pera o qual se entra pela Biblioteca do Vaticano. E p.a o duplicado, de q̃ tambem ha grande precisão, se escolherá sitio separado.

15. — E determinado e escolhido este lugar d'entre S. João dos Bemcasados e o conv.to de N. Sr.a da Estrella p.a o novo e real Palacio, me parece se deve principiar a renovação da cid.e de Lix.a pelos edificios publicos, que são fabricados por conta da real fazenda, por serem os pr.os fundam.tos dos reaes subsidios quasi todos na marinha, p.a o q̃ largará S. Mag.e o seu Palacio antigo, assim como os Sr.es Reys seus antecessores havião largado os em q̃ habitavão, q̃ se achão hoje servindo de outros uzos: e poderá tambem formarse a caza da bolça do neg.o e tudo com as direcçoens, e formalid.es não só segundo as not.as das outras Cortes, mas com as melhoras q̃ ocorrerem, e o bom discurso alcançar.

16. — As communicaçoens da 1.a praça do terr.o do Paço p.a dentro da cid.e se devem abrir as 1.as em correspond.a ás duas ruas dos ourives do ouro e da prata, evitando todas as pasagens cubertas q̃ são incidiosas de noite.

17. — As ruas de cazas q̃ de novo se fabricarão p.a a communicação do novo Palacio com a cid.e antiga se emprenderão depois das d.as reaes obras; mas ou sejão edificadas de madr.a ou de pedra e cal, nunca a altura das cazas excederá a largura das ruas, e q.do as ruas forem mais largas q̃ a altura dos dous pavim.tos sobre as logeas, nem por isso as cazas poderão subir a terceiro pavimento.

18. — E pelo q̃ pertence a renovação da cid.e arruinada me acomodo ao 4.o modo já assinado, valendome de conservar os entulhos p.a dar mayor altura ao pav.to da cid.e baixa, principiando a alteala do adro do conv.to da Annunciada, do adro do conv.to de N. Sr.a da Boa Hora, do adro da Ermida de N. Sr.a da Assumpção da rua dos ourives da prata, e a esta imitação todas as mais ruas q̃ estiverem no mesmo livelam.to formandose hũa tal descida p.a o mar q̃ vá fenecer pela porta da Alfandega do tabaco.

19. — P.ª se poderem dirigir as ruas na forma mais regular se sinalarão primr.º com bandeirolas firmes todas as ruas destruidas p.ª se reconhecer por este modo o terreno q̃ occupavão as cazas e ruas, e poderse emmendar com clareza, o q̃ se julgar necessr.º evitandose deste modo o perigo q̃ pode haver q.do unicam.te se guiarem por plantas; como já tem sucedido, e poderse sobre esta not.ª pratica e palpavel tomar a rezolução de como se hão de suprir as diminuiçoens q̃ houverem nas propried.es, o q̃ necessita de m.to especial attenção.

20. — Parece porem preciso determinarse se nas ruas principaes deste bairro baixo e plano se devem formar columnatas como havia na rua nova dos ferros e confeitaria p.ª comodid.e da passagem da gente em tempo de inverno, e chuvoso, não excedendo porem a altura das cazas os d.os dous pavim.tos hum dentro das columnatas, e outro sobre ellas.

21. — Declaro q̃ o reservar p.ª ultimo lugar esta operação he p.ª dar tempo a q̃ o grande n.º de corpos immersos pelos entulhos não possão produzir algũa corrupção no ar, descobrindose, e pela mesma razão procuro tambem altear as ruas p.ª não haver tanta necessid.e de os revolver; pertendendo tambem com esta dilação suspender o horror em q̃ o publico se acha contra os edif.os q̃ não são de simples madr.ª alem de que por falta de meyos receyo m.to que haja grande difficuld.e em edificar de outro modo, porq̃ os incendios extinguirão quasi todos os cabedaes dos habitantes de Lix.ª

22. — Nesta pr.ª parte da prez.te Dissertação procurei expressar em generalid.e o q̃ na imaginação embaraçada com hum tão raro caso me foi possivel revolver, sujeitandome de m.to boa vont.e a toda a correcção judiciosa, q̃ emmende melhor ou reprove o q̃ achar q̃ o merece, porq̃ do mesmo modo q̃ estimaria tivesse boa aceitação o que proponho, igualm.te estimarei a justa reprovação antes q̃ a execução o embarace; com a differença som.te que deixarei de me empregar em segunda e individual parte, se na pr.ª me tiver afastado do q̃ for mais conveniente ao Real serv.º e bem do publico; pois q̃ nas individuaçoens periga m.to mais o acerto q.do a generalid.e se tem afastado da rectidão. 4 de Dez.º de 1755. Lix.ª M.el da Maya.

ii) Segunda Parte

1. — Visto parecer que vai tendo algũa aceitação a 1.ª p.te da minha Dissertação sobre a renovação da Cd.e de Lix.ª he precizo animarme a individuar a 2.ª, como prometi no ult.º § da 1.ª, não obstante terlhe reconhecido m.to mayor dificuld.e. Valerme-hei porem do mesmo methodo q̃ segui na 1.ª, indagando por p.tes a natureza de todas as que me propuzer p.ª fazer eleição, p.ª q̃ q.do não chegue a determinarme inteiram.te, ao menos mostre q̃ as ponderei até onde a minha possibilid.e pode alcançar, ficando assim aberto o cam.º p.ª q.m com melhor vista possa reconhecer distintamente as ventagens e os defeitos q̃ eu não chegar a perceber.

2. — Procedo na suposição de S. Mag.de fazer eleição do sitio medio entre S. João dos Bemcasados e o Conv.to de N. Sr.ª da Estrella p.ª o seu novo e real Palacio, ficando aquele sitio cabeça e parte principal da Corte e Cid. de Lix.ª, ao q̃ precizam.te se hade seguir a renovação do corpo da mesma cid.e destruida, p.ª o q̃ se mostra m.to apropriado o 4.º modo da renovação da cid.e expressado no § 6 da d.ta 1.ª parte q̃ diz assim etc.

3. — Que se queira renovar a cid.ᵉ baixa he pᵃ mim indubitavel; porq̃ ainda sem haver occazião tão forçosa, se tem mostrado esta vontᵉ assim na rua nova do Almada q̃ se formou qᵈᵒ o bairro alto não tinha melhor serventia que a rua, ou beco dos Fornos, as ruas dos ourives de prata, e do Ouro, por onde não podia passar mais q̃ hum carro, e proximamᵗᵉ a preparação pᵃ se alargar mais a dᵗᵃ rua nova do Almada até a rua larga das portas de S. C.ᵐᵃ, formada assim em sincoenta.e quatro palmos de largo pela ley do alinhamento q̃ não teve procurador q̃ a fosse fazendo executar em todas as pᵗᵉˢ em q̃ houvesse renovaçõens de cazas: e á vista dos referidos exemplos parece indubitavel a renovação de Lixᵃ baixa. O que porem resta he eleger o meyo mais ajustado pᵃ se conseguir este muy louvavel benefº, pᵃ o que declaro q̃ qᵈᵒ expuz aqˡᵉ 4.º modo da renovação de Lixᵃ, arrazando a sua pᵗᵉ baixa, foi na expectação de q̃ S. Magᵈᵉ poderia escolher o meyo de tomar a si todos os edificios de tal pᵗᵒ da cid.ᵉ depois de avaliados no estado em q̃ se achassem, pᵃ q̃ depois de derribados e extintos, formadas novas ruas e novos logares pᵃ os edificios novos, e repartida por elles a importᵃ ou valor das cazas destruidas, e conhecido o que correspondia a cada palmo, vara ou braça quadrada, cada acredor de edificio recebesse em terreno a avaliação q̃ se lhe havia feito, e qᵈᵒ lhe não agradasse, se vendesse aqᵐ desse a sua importancia pᵃ a receber o acredor: e no cazo q̃ ainda nisto houvesse algũa duvida, mandasse S. Magᵈᵉ edificar por sua conta pᵃ recolher a seu patrimonio o rendimento por me parecer este o modo mais dezembaraçado e mais prompto, persuadindome q̃ assim se haveria observado em Turim e em Londres, qᵈᵒ alli se fizerão semelhantes renovaçoens; o que porem não posso segurar, porque o fogo me despojou de todos os meyos de que me costumava valer em occasioens semᵉˢ E qᵈᵒ eu vi que se mandava formar hũa especie de Tombo dos edifᵒˢ da cid.ᵉ de Lisboa com as suas avaliaçoens me pareceo estar adoptado este 4.º modo de renovação; mas porq̃ bem pode suceder q̃ a mesma especie de Tombo possa tambem servir para outra diversa forma de renovação, segundo a nova ordem com q̃ se vão acomodando os entulhos, cada hum ao edificio de q̃ sahio, pᵃ que cada dono se possa aproveitar dos materiaes que nelles achar, reedificando á sua custa, parece não se querer S. Magᵉ servir do dito 4.º modo na forma deq̃ eu o havia proposto, derribando, e destruindo a Cid.ᵉ baixa, levantandoa no que fosse proveitoso com os seus entulhos, pᵃ q̃ depois com novos e melhores materiaes e nova forma, se reedificasse a cid.ᵉ cuja idea parece desvanecida com a nova deligencia da accomodação dos entulhos e dos materiaes q̃ comprehende.

4. — Mas porq̃ se não pode entender qᵗᵃ S. Magᵉ mandar conservar a cid.ᵉ baixa com a mesma forma das ruas q̃ tinha, mas q̃ sempre hade querer q̃ os donos dos edificios as reduzão a melhor forma, me parece ser o tal modo o de conservar algũas ruas no seu próprio estado, como as ruas dos ourives do Ouro da Prata, a rua nova dos ferros, e ainda a dos Escudrᵒˢ e Odreiros; mas que as ruas da correaria, das arcas, cutelaria, espingardrᵒˢ, Mᵗ Gonçalo, Pixilrᵒˢ, esteiras, e Mercadores, por detras de S. Julião pᵃ a Conceição, e a rua nova da Palma se alarguem por hũa pᵗᵉ ficando a outra conservandose no estado em q̃ se acha, mas q̃ esta pᵗᵉ conservada pela melhora q̃ alcança e sem detrimᵗᵒ, na tal largura, concorra pᵃ compensar a pᵗᵉ contraria o detrimento q̃ experimenta, assim na diminuição do valor da propriedade como da despeza da obra aque fica sujeita cuja resolução directamente pertence aos Ministrns de S. Mgᵈᵉ O que assim vencido resta saber se hade passar a mais a renovação da cid.ᵉ baixa, formando-se ruas novas, como de S. Nicolau pᵃ a rua nova dos ferros; do largo da Igrᵃ da Victoria pᵃ o Tronco, e dahi ao

meyo da calcetaria; e outras q̃ se poderão formar de novo, destruindo m.tas cazas inteiram.te e cortando outras com m.ta irregularidade, noq̃ me parece se encontrarão embaraços muy dificeis de ajustar e de compensar e q̃ serão mayores q̃ os proveitos q̃ se poderão tirar das taes innovaçoens de ruas: pelo q̃ me parece q̃ nesta forma de innovação seria mais conveniente q̃ senão entendesse, alem de alargar as ruas estreitas, conservadas por hum lado; porq̃ o despedaçar becos e cazas q̃ os acompanhão só me parece praticavel q.do se arruinasse a cid.e baixa inteiram.te e se uzasse da sobred.a compensação expressada no § 3. He preciso tambem determinar se as ruas q̃ se conservarem inteiras, como a rua nova dos ferros, a dos Douradores, a dos Escudr.os, a dos Odreiros, q̃ não são inteiram.te em linha recta, se se hão de obrigar seus donos a q̃ as emmendem, oq̃ tambem hade causar grande viol.a e m.tos requerim.tos e deprecaçoens, pelo q̃ dos 3 modos da renovação da cid.e baixa, o 1.º arrazandoa toda e renovandoa toda, tenho por superior e melhor; o 2.º de conservar as ruas largas, a alargar as estreitas mencionadas tenho por mediado: e o 3.º de querer tambem accrescentar ao 2.º a reducção dos becos e travessas a ruas largas tenho por infimo.

O abrir serventia descoberta e larga do terreiro do Paço p.a a rua nova, em todos os tres casos he indispensavel; se for hũa só, poderá sair ao meyo da rua nova; e se forem duas, poderá ser a 2.a em frente da rua dos ourives do ouro. A rua nova do Almada sempre se deve adoçar, não só p.a facilitar a subida do Bairro Alto, mas p.a dar melhor saida ás aguas, onde se junta com a calcetaria e pé da calçada de S. Franc.º e largo da Patriarcal. A calçada de Pedro de Novaes tambem está pedindo q̃ a facilitem, principiando este beneficio da rua e largo detras da Igr.a de N. S.a da Vitoria, travessa dos Espingardr.os e calçadinha que sobe p.a a Cruz do Carmo, fazendo-se logo calçada em tudo o q̃ se for entulhando, p.a q̃ a agua da chuva não descomponha logo o entulho. Esta rua de Pedro de Novaes tambem necessita de se alargar por hũ lado e tambem a comq̃ se entra do largo da Victoria p.a o q̃ se lhe segue em frente das cazas altas da congregação do Oratorio, dando por ella principio a melhora da d.a calçada de Pedro de Novaes, como tambem necessita m.to de alargada q̃ a fas serventia da rua das Flores p.a a cruz de Catequefarás.

5. — Para se reformar a cid.e baixa na forma apontada no d.º pr.º modo dos 3. expressados nesta 2.a p.te (a q̃ me inclino) a pr.a dilig.a consiste em q̃, feitas as avaliaçoens de todas as propried.es de casas q̃ se hão de derribar, cada hũa de per si com o nome de proprietario, qualid.es de suas obrigaçoens, ou sejão morgados, cap.es ou foros, p.a q̃ a compensação q̃ se der a cada proprietario, fique com as mesmas obrigaçoens primitivas; e sobre hũa planta nova da cid.e baixa com as ruas livrem.te desenhadas, conservando porem as Igr.as Paroquiaes, Ermidas e Conv.tos e as extensoens das Freg.as nas suas mesmas situaçoens o mais ajustado q̃ fôr possivel, se calcule q.tos palmos superficiaes vão comprehendidos nas areas determinadas para serem occupadas de edificios; e sabido ao todo o valor de todas as casas derribadas, se reparta este pelo n.º de palmos superficiaes comprehendidos nas d.as areas, e desta repartição se conhecerá o valor que compete a cada palmo, e segundo o valor de cada edificio derribado se lhe commutará o tal valor com o n.º de palmos superficiaes q̃ lhe competirem; com advertencia porem q̃ sempre se attenderá a qualidade dos sitios, recompensando o sitio de cada acredor com outro sitio semelhante: ao que fosse mais proximo ao mar, com sitio mais proximo ao mar, e ao q̃ fosse mais proximo ao rocio, com sitio m.º proximo ao rocio; e assim aos mais acredores;

e a todos se determinará tempo certo para darem principio ao edif.º p.ª o terem tambem completo a tempo determinado, seg.do os desenhos q̃ lhes forem communicados p.lo Architecto de senado o Cap.am Eugenio dos Santos e Carv.º, p.ª que cada rua conserve a mesma simetria em portas, janellas e alturas; e pelo q̃ toca a cotas me parece sejão todas de dous pavim.tos sobre as logeas; porem q̃ as paredes que dividem os edificios excedão a altura das paredes das frontarias pelo que se julgar bastante p.ª q̃ o fogo senão possa communicar de huns telhados a outros, como costuma suceder por não haver esta cautela, e não deixa de ser bem empregada a despeza q̃ demais se faz naquella porção de parede, pela defeza comq̃ cada edif.º se prepara contra hum tal inimigo. Disse asima, p.ª que cada rua conserve a mesma simetria em portas e janellas e alturas, porq̃ me parecia melhor que cada rua ou cada Freg.ª tivesse algũa diversid.e ao menos na côr da pintura do que por toda a cid.e baixa inteiram.te uniforme, até p.ª não ficarem tão distintas as outras p.tes da Cid.e que se conservarão na mesma forma em q̃ se achão, porq̃ tenho moralm.te por impraticavel a renovação inteira de Lix.ª em todas as suas Freg.as; mas esta minha imaginação não impede q̃ depois de vencida a reformação da cid.e baixa, se possa com melhor segurança emprender o q̃ agora tanto se me difficulta.

6. — E posto que se reprez.te este projecto o mais expedito, e mais livre dos embaraços q̃ nos outros dous concorrem, e a ventagem de ser o q̃ depois de conseguido não padecerá a desgraça de arrependimentos porq̃ como vae acompanhado de todas as melhoras possiveis, não fica lugar aq̃ se lhe notem os defeitos q̃ nos outros se poderão notar. Resta ainda vencer o embaraço deq̃ como p.ª q̃ as casas conservem hũa boa simetria, devem todas conservar entre si correspondencia, e será m.to rara a occasião emq̃ o n.º de palmos superficiaes ou areas q̃ corresponder pelo preço estimado a hũ acredor p.lo edif.º em haver diferença de mais ou menos area; p.ª vencer esta dificuldade será precizo q̃ determinados na nova planta os novos edificios com a sua ajustada simetria se ponhão estes em venda, preferindo p.ª a compra os acredores com a condição que no caso q̃ a area q̃ cada hũ receber tiver mayor valor q̃ aq̃ deixou, entregue o excesso p.ª com elle se ir satisfazendo a outro credor que receber area de menor valor q̃ a que deixou, e nesta formalid.e de entregarem os acredores em dinh.º o excesso da area q̃ receberem de mayor preço do q̃ lhes competia ou recebendo em dinh.º aquelle q̃ completar o valor da area que deixou no caso de não querer lançar mão de mayor area, se ajustará a compensação; e q.do sobejarem areas que os credores não queirão comprar, se venderão aos q̃ não forem credores, p.ª os acredores receberem em dinh.º oq̃ lhes pertencer; e se houver credores q̃ queirão comprar mais areas das q̃ lhes pertencerem, com esta extensão de compras poderá ser prejudicial a outros acredores q̃ quizerem tambem areas, e não dinh.º; neste caso se suspenderá o d.º excesso de compras, q̃ só lhes será permitido qd.º faltarem acredores q̃ qucirão antes dinh.º do que arcas.

7. — E p.ª vencer o receyo de faltar q.m queira comprar algũas areas, nem acredores recebelas pelas q̃ deixarão, me occorre responder q̃ como a todos os homens de neg.º he m.to conveniente terem as suas habitaçoens proximas aos Tribunaes deq̃ dependem, a principiar S. Mg.de a renovação de Lx.ª, como já apontei no § 15.º da minha 1.ª parte, pelos edificios publicos, que são fabricados por conta da Real Fazenda quasi todos na Marinha, me faz persuadir q̃ com este atractivo procurarão todos os q̃ tiverem depend.ª dos taes tribunaes alcançar sitios e areas p.ª edificar, não reparando em dar por hũa vez hũa só quantia ainda q̃ grande em esperança deq̃ com o tempo recuperarão

abundantem.te nas habitaçoens proximas aos tribunaes, deq̃ quotidiam.te dependem p.a os seus interesses, e q̃ com hũ tal atractivo se facilitará m.to a reedificação de Lix.a baixa com as ventagens premeditadas no d.o modo de a renovar, arrazando-a; mas emq.to me conservo na esperança de q̃ possa ter effeito o projecto proposto com o atractivo dos Tribunaes publicos feitos, em 1.o lugar me lembro deq̃ o Tribunal da Alfandega q̃ costuma occupar m.to sitio, e diversas estaçoens, segundo a variedad.e de fazendas q̃ nellas se despachão, se podia reduzir a hũa summa abreviatura á imitação da Inglaterra, emq̃ as fazendas despachadas ainda dentro dos navios, vão dalli p.a casa de seus donos, determinando-se caes proprios p.a o dezembarque e conferencia dos despachos, evitando o trabalho dobrado de as levar primeiro a Alfandega, e os perigos q̃ algũas vezes na mesma Alfandega experimentão de agua, fogo e roubos; e não posso persuadirme q̃ os Inglezes cuidão menos no interesse dos dir.tos reaes, q̃ os Portugueses; e como a casa da Alfandega se acha tão arruinada parecia boa occasião de mudar de estilo, poupando tempo e dinh.o que na sua creação se ha de gastar.

8. — Atéqui me tenho aplicado a individuar a renovação da cid.e baixa, e como na supposição em q̃ procedo de S. Mag.e lançar mão do sitio de S. João dos Bemcasados e o convento de N. Sr.a da Estrella, toda a Freg.a de S. Isabel fica inclusa na cid.e e Corte de Lx.a emq̃ se vae edificando sem ordem nem simetria, oq̃ já no tempo do Sr. Rey Dom João V se havia principiado a fazer, sobre o que fiz hũa representação ao mesmo Rey e Sr., p.a q̃ quizesse ser servido ordenar ao senado da Camara désse forma á innovação das ruas q̃ se hião aumentando nos suburbios determinandolhes as larguras q̃ havião de ter assim as principaes como as travessas, determinando p.a estas 25 palmos ao menos, e p.a as ruas principaes a largura da rua dos Ourives de Ouro e de Prata. Determinando também lugares mayores p.a praças e mercados; e foi o mesmo Rey e Sr. servido ordenalo assim per seu Real Decreto q̃ ficou registado na Secretr.a de Estado, e no cartorio do d.o Senado não pode tambem deixar de estar registado; e não posso nomear o dia nem o anno, porq̃ não tenho hoje memorias deq̃ me valer, e agora no prez.te tempo emq̃ vão crescendo tanto os edif.os sem regulam.to algum, me parece ainda mais necessario regulam.to mais ajustado, q̃ bem entendido deve ser, q̃ o senado, com o seu Arquitecto e Mestres, vá demarcar e balizar os comprimentos e larguras das ruas q̃ se vão acrecentando á cid.e antiga, e ao mesmo tempo formando a planta das ruas novas, porq̃ deste balizam.to depende a boa ordem que as ruas novas podem observar ficando as plantas servindo p.a tirar algũas duvidas q̃ depois das demarcaçõe podem sobrevir. Advertindo q̃ p.a esta innovação de ruas he mais proprio o balizam.to e demarcação sobre o terreno aq̃ se deve seguir a planta p.a memoria, doq̃ fazer pr.o a planta ideada p.a a demarcação do terreno.

9. — E porq̃ depois de determinadas as ruas e praças he conveniente q̃ os edif.os observassem simetria na altura das casas, forma das janellas e portas, seria tambẽ justo q̃ o mesmo Arquitecto do senado, assim como ha de dar desenhos para a renovação da cid.e baixa arruinada, os dẽ tambẽ p.a esta p.te q̃ de novo se edifica.

10. — Tambem se me faz preciso advertir q̃ se devem aclarar os limites da fortificação de Lix.a p.a q̃ os novos fabricadores de edificios não vão occupando terreno prohibido, cuja incumbencia poderá ter o sarg.to mor Filippe Rodrigues de Olivr.a acompanhado do Vedor Geral das Fortificaçoens, e de seu escrivão, assim porq̃ já a andou observando na averiguação das fazendas q̃ p.a a d.a fortificação foram compradas, como também por ter sido privilegiado do fogo q̃ lhe não roubou os seus papeis, entre os

quaes conserva o da d.ª fortificação; e p.ª esta diligencia ser completa se porão balizas firmes nos lugares prohibidos, assim dentro, como fora da fortificação, que determinem os lugares exceptuados p.ª se não fazerem nellas obra algũa de pedr.º, e algũa q̃ houver já de carpintr.º não possa ter posse de conservação, com a obrigação feita na Vedoria p.ª a derribarem todas as vezes q̃ for ordenado, sem se poder requerer satisfação algũa, antes pagarão na mesma Vedoria, q̃ o he tambem da Fortificação, oq̃ este lhe ordenar em reconhecim.to de vassalagem. E ao Marquez Estribr.º mor Gov.or das Armas da Provincia da Extremadura e Corte, como Superintendente das Fortificaçoens me parece pertencer mandar executar esta dilig.ª ordenando-lhe assim S. Mag.e.

11. — E he q.to me occorre dizer nesta 2.ª p.te reservando p.ª a 3.ª o q̃ depende de planta, p.ª cuja execução me tenho achado m.to falto de preparativos e comodid.e porq̃ a destruição experimentada que penetrou os lugares ainda mais reservados, como se fosse enviada p.ª destruir q.to pudesse ter algum uso aos viv.tes que restarão, ficando por este modo extinctos nos seus exercicios, ainda q̃ vivos p.ª se lembrarem do q̃ perderão, tambem fez caso de mim p.ª mostrar q̃ lhe não escapou cousa algũa, por diminuta que fosse. A mat.ª q̃ se trata, ainda q̃ não seja tão nova que deixe de ter havido outras semelh.tes, he comtudo necess.º ponderarlhes as differenças das ocaasioens em que se fizerão, porq̃ nem em Londres, nem em Turim se achavão os povos flagelados como os de Portugal quando se reformarão aquellas cortes, e vae m.ta diferença de obras em tempo mais ou menos calamitozo p.ª ser mais ou menos facilitada a execução. P.ª esta se conseguir sempre será hũ grande adjutorio a saude bem conservada: as aguas corruptas, e sem movim.to, assim na rua nova dos ferros como no Rocio, sem despejo, não deixão de correrem perigo de corromper o ar; he ponto pertencente ao Tribunal da Saude e do Senado da Camara, q̃ o governa, e entendo senão devem desprezar sem ofensa do bom regimen. Lix.ª 16 de Fevr.º de 1756.

iii) Terceira Parte

§ 1.º No § ultimo da segunda parte da Dissertação sobre a renovação de Lisboa, prometi esta terceira muy dependente de plantas, e desenhos que não posso executar como costumava fazer, sendome preciso valerme de outras pessoas sem ser em minha prezença por falta de commodo que ainda me não tem sido possivel conseguir, consequência dos fatalissimos flagelos q̃ se tem manifestado á nossa admiração: Valendo-me porem dos officiaes Engenheiros e Praticantes da Academia Militar, de que me pareceo fazer eleição, e communicandolhes a planta da parte baixa de Lisboa destruida que só me escapou da voracidade por se achar fora da minha mão, lhes expliquey a mudança que pretendia mostrar por plantas novas em que se podesse fazer conceito dos remedios premeditados, intimando ao Ajudante Pedro Gualter da Fonseca, acompanhado do Praticante Francisco Pinheiro da Cunha, tomasse por sua conta expressar em huma planta sobre a representação da parte baixa de Lisboa destruida, a emmenda das ruas estreitas, de mais uzo, e algum melhoramento nas largas, para que se se quizer lançar mão d'esta emmenda proposta no principio do § 4.º da segunda parte, se antevisse a melhora que se conseguia: e que tambem sobre os becos miudos apontace

novas ruas, para que se podesse sobre ellas observar se seria escuzado aquelle melhoramento, ou inevitavel, conservando nos seus proprios sitios os Templos, Ermidas e Freguezias com o seu terreno competente; e mudando a largura do terreiro do Paço em comprimento, extendendo-se para a parte do mar the emparelhar com o comprimento da ponte da Caza da India, ficando sendo a sua largura desde o Forte the á face do poente da Alfandega do Tabbaco, e formando a caza da bolça dos homens de negocio entre a dita Alfandega e o arco do Assougue, separada por duas ruas, huma da parte da mesma Alfandega, e outra da parte do mesmo Assougue para darem serventia para a praça restante, entre a dita bolça e Caza dos Contos, que servirá para os uzos q̃ costumava servir, mas sem inficionar a praça principal, derribando-se o baluarte, e sua cortina, e fazendo-se no extremo do comprimento desta nova praça escadas para dezembarcar em toda a maré sem necessidade de pranchas, e dando-se commodo para a Vedoria e Academia Militar entre a ponte da Caza da India, e o Forte, o q̃ vay representado na planta n.º 1.

2.º Ao capitão Elias Sebastião Pope, acompanhado de seu filho o Praticante Joze Domingos Pope, entreguey outra planta da parte baixa de Lisboa destruida intimandolhe outra (planta da) renovação (para o mesmo fim), com a differença porem q̃ não tratasse de melhorar ruas estreitas, nem aproveitar-se das largas inteiramente, mas que com a liberdade q̃ julgasse apropriada formasse huma nova planta com as mais condições apontadas na primeira intimação: O que apprezento executado na planta n.º 2.

3.º Ao Capitão Eugenio dos Santos de Carvalho, acompanhado do Ajudante Antonio Carlos Andreas, entreguey outra planta da parte de Lisboa baixa destruida, para que sobre o terreno que occupara formasse outra nova planta com toda a liberdade inteiramente, e sem sogeição nem preceito algum mais que a conservação dos Templos, Ermidas e Freguezias: o que vay executado na planta n.º 3. Recommendando geralmente a todos tres formassem algumas praças em lugares convenientes para q̃ nestes vazios tivesse o ar commodos em que produzisse os seus bons effeitos.

4.º E porque entre os tres pensamentos propostos se achão diversidades que poderão ser mais ou menos agradaveis, e o meu intento he somente apontalos, não duvidando q̃ (ainda sobre os tres modos propostos) se possão sinalar outros melhores, para o que poderão servir de grande adjutorio estas tres reprezentações, porque á vista das diversas configurações de hum objecto, he q̃ milhor se pode observar a sua propriedade, ou impropriedade, aproveitando-me do mesmo soccorro, noto na planta n.º 3.º que o terreiro do Paço nella desenhado, excede quanto a mim a grandeza de praça; mas q̃ o molhe q̃ forma na Alfandega para que os barcos carregados e nelle recolhidos possão com toda a commodidade descarregar dentro da mesma Alfandega, sem adjutorio da ponte, me parece muito bem advertido.

5.º Suppondo (porem) que se acceita algum dos planos propostos, resta ainda depois de demarcados os sitios edificandos, e determinada a commutação dos destruidos, escolher com antecedencia o modo com que se devem preservar as ruas livres dos embaraços que as fazem immundas, fazendo elleição do mais apropriado para este fim; e porque sobre o ordinario de que se costuma uzar, q̃ consiste em serem conduzidas pellos carretães em cargas de bestas todas as superfluidades q̃ se lanção das janelas, ha somente tres q̃ podem concorrer para a elleição, declaro que o primeiro (de que se tem uzado alguns paizes) consiste em que, fabricadas pello meyo das ruas (principaes) cloacas com

capacidade para receberem as agoas e (todas as) superfluidades dos edificios, sayão destes os conductos subterraneos pellos quais os edificios se aliviem nas cloacas: alguns conductos destes se fizerão em Conventos e edificios particulares d'esta Cidade, e se introduzirão nos canos reais, mas tem sido em pouco numero; advertindo que os canos reais q̃ são as cloacas antigas de Lisboa, pella mayor parte se não achão capazes de bom serviço por estarem muito corruptos e pella mudança das ruas, que provavelmente se seguirá, poderá ser preciso haver mudança nas suas situações.

6.º Consiste o segundo em reconhecer que em algumas partes se uza de carretas que vezitando de manhã as ruas, e recolhendo os lixos e superfluidades solidas, as alivião, e defendem do mayor embaraço, ficando só sogeitas ás agoas q̃ com facilidade se dicipão.

7.º Consiste o terceiro em deixar livre entre cada duas ruas, e as duas ordens de edificios q̃ as formão por hũa de suas partes huma rua estreita de sinco ou seis palmos que chamão, alfugere, sem que hajão para ella portas, mas só janelas de que se lancem nella as tais superfluidades, que no Outono costumão ser extrahidas pellos carretões, para serem lançadas em lugares determinados; e em algumas partes desta Cidade, se achavão as tais alfugeres, posto que com o inconveniente de inficionarem o olfato dos moradores daquellas cazas a que ficão contiguas, q̃ necessitão de vidraças para moderarem aquelle inconveniente, ou custumarem-se a sofrello; pello que dos quatro modos referidos, sempre o do conductor subterraneo para as cloacas me parece o milhor onde as houver: o dos carros, ou carretas, havendo a quantidade sufficiente, estimo em segundo lugar; e em terceiro, o commum e uzados carretães, e ultimamente o das Alfugeres, q̃ alem do seu perpetuo inconveniente, deminuem o terreno dos edificios. A consideração porem da diversidade das despezas, poderá alterar muito este meu parecer, que sempre como tudo o mais deixo pendente da melhor ponderação.

8.º A esta consideração de conservar as ruas de Lisboa livres dos embaraços que as fazem immundas, para o que concorrerá muito a mayor largura das ruas, e a menor altura dos edificios, não excedendo de dous pavimentos sobre as loges, se segue necessariamente outra não menos importante, e consiste em determinar melhor lugar em que possão os tais embaraços ser lançados com menores inconvenientes; e por que me occorre hum mais livre delles do que os já observados, e promete huma grande conveniencia ao bem publico, sejame licito prezentalo neste lugar. Consiste elle em q̃ os tais embaraços se vão lançar dentro do Rio de Sacavem, para que com este adjutorio se chegue a formar nelle hum valle á imitação do de Chelas, em que as agoas salgadas chegavão em algum tempo ao templo das Virgens Vestaes, hoje Convento de relligiozas de Sancto Agostinho; por q̃ se este pequeno Valle soccorre tão agradavelmente a Corte com as suas hortaliças e frutas, quanto melhor o fará o Valle de Sacavem com a sua muitas vezes mayor grandeza, e sem se poder dizer que os embaraços ali lançados podem cauzar algum impedimento na barra, como se pode temer de qualquer dos outros modos em que se não lanção em terra: pode esta consideração ter contra si o embaraço do refugio das embarcações no tempo em que se recolhem a buscalo; mas a isso se pode responder q̃ nem as embarcações necessitão de todo o esteyo de Sacavem para se refugiarem, nem seria justo q̃ inteiramente se lhe impedice o refugio, mas que só se formasse em Valle aquilo que lho não impedice q̃ sempre será de grandeza muy proveitoza.

9.º Também parece precizo attenderse com antecedencia aos conductos da agoa para as fontes de que he muito justo se milhore esta cidade baixa destruida, para alimento dos povos para extincção dos incendios, e para adorno das praças: no terreiro do Paço pode servir a agoa q̃ vem das Cruzes da Sé: na praça do Rocio, pode o seu chafariz receber mayor agoa, e mais segura do bairro alto, ficando a que de prezente lança ao Desterro de donde traz a sua origem, onde tambem he necessaria para acodir ao muito povo que naquella circumvezinhança tem crescido: O Hospital Real de todos os Santos pellos seus grandes privilegios se faz acredor de toda a agoa q̃ lhe é necessaria: O largo da Victoria está pedindo com muita razão ao bairro alto hum soccorro de agoa: o bairro de S. José o imita com a mesma justiça, por que ali a virão buscar do Campo do curral onde não ha a sufficiente: e estes lugares da Cidade baixa que tenho apontado, são os inexcuzaveis deste soccorro, porque se fosse possivel q̃ em cada rua houvesse huma fonte, ou cada caza tivesse huma chave de agoa, nunca se poderia chamar superfluo este melhoramento: mas pois que o não pode ser em todo, para q̃ ao menos o possa ser em parte, se devia fazer alguma delligencia, para se convocarem, e ajuntarem mais agoas, pois para isso forão formados dous encanamentos no Acqueducto q̃ conduz a agoa para o bairro alto, no que se não tem posto thé o prezente aquella applicação q̃ a materia merece, e com que se poderão conseguir, segundo os apontamentos que para esse fim forão feitos, q̃ posto o fogo os consumice todos, ainda se acharão alguns vestigios na idêa.

10.º E porque a agoa sem instromentos com q̃ se applique he como espada sem braço, e as bombas o custumão ser, devem estas acharse repartidas em lugares convenientes, e ao menos hũa em cada freguezia, e junto da mesma Igreja para o que se determinará edificio particular de que poderá ter a chave o andador da Irmandade do Santissimo Sacramento, por se achar ordinariamente assistindo na Igreja, ou perto della: Os baldes de couro em bom numero são inseparaveis das bombas, para com promptidão e segurança ajudarem neste conflicto: cuja repozição deve ser muito observada por meyo de alguma horroroza penna contra quem tiver o desacordo de os não repor em seu lugar, achandose em qualquer mão fóra delle.

11.º Não posso deixar de acrescentar aqui ser muito preciza huma especial attenção na elleição das pessoas que hajão de ter por sua conta a execução desta difficultosa obra da renovação de Lisbôa baixa, para a guiarem livre dos embaraços q̃ se poderão encontrar, ou incluir entre a correspondencia do antigo com o moderno, no cazo de haver alguma commutação do velho, com o novo que he aonde consiste a mayor difficuldade; para cuja solução não julgo inteiramente sufficientes adjutorios das plantas, e se faz muito precizo que se vão observando no terreno com todo o género de precauções q̃ a materia merece; por que sendo certo q̃ se não uza de getipé nos planos das cidades antigas tão irregulares como custumão todas ser, não se pode uzar delles como de hum plano regular de hum Convento ou de hum Palacio: E ainda q̃ a nossa planta de Lisbôa antiga se avantage em se lhe ter assignado petipé, nem por isso se deve caminhar por ella, sem ser como com huma continuada sonda reta por cauza da dita commutação; porque o formar huma Cidade de novo sem attenção mais que a ella propria, unindoa a outra antiga como em Turim, será mais divertimento que trabalho; para esta execução me persuado estarem em primeiro lugar o Tenente Coronel Carlos Mardel e o Capitão Eugenio dos Santos de Carvalho, porque álem de serem Engenheiros de profição, são tambem na Architectura Civil os primeiros Architectos.

12.º E como athé o prezente se não sabe o modo de commutação q̃ se uzará com os donos das cazas destruidas, e a conjectura q̃ eu fazia era na suppozição de que na deligencia q̃ em forma de tombo se executava pellos bairros, se incluia a avaliação dos edificios, o que com effeito não he assim, mas só consiste na medição das areas, e algumas clarezas q̃ não comprehendem a avaliação, me vejo obrigado a entender que, ou esta avaliação se fará separadamente por segunda deligencia, prezentes os mesmos edificios ou não prezentes, ou que se não quer uzar mais que de medições das Areas, para serem commutadas por areas; porque como na renovação da Cidade baixa por ruas largas, se mudão totalmente os sitios dos edificios que não são mandados avaliar, parece poder ser o intento da commutação por Areas correspondentes, assim aos sitios mais ou menos proximos do mar, como á grandeza mayor ou menor, correspondente á do edificio destruido; mas como se não pode entender q̃ por cauza da mayor largura das ruas restem areas para suprir as dos edificios destruidos, segue-se deste conhecimento que commutando-se as areas com igualdade, hão de faltar areas para completar as de muitos edificios antigos, que ou se hão de suprir com areas em outros sitios novamente determinados, ou em dinheiro no cazo dos donos dos tais edificios se não conformarem com a tal commutação. Se porem se julgar licito que se faça huma commutação de areas proporcionada de outro modo, isto he, sabendo ao todo a area de todos os edificios destruidos, e sabendo também ao todo a area dos terrenos edificandos, e observando a proporção entre estas duas areas totais; e fazendo sobre ella, e á sua imitação, a commutação das areas particulares, não seria necessario suplemento de areas, e ficarião todos com areas correspondentes, ainda que menores das que tinhão; no que serião mais intereçados os das ruas estreitas extinctas pellas vantagens das ruas largas; e no cazo de não servir de obstaculo esta diversidade para se fazer a compensação, resta ainda averiguar como se há de suprir o mais ou menos de area que a alguns acredores faltar, ou crescer para bem edificar; o que já no § 6.º da segunda parte desta dissertação supriamos por meyo das avaliações que suppunha se fazião: mas como já reconheço se não tem feito, e q̃ sem ellas me não occorre suplemento para os tais cazos, parece q̃ para elles são as avaliações inevitaveis se se houver de abraçar o dito modo de compensação; e no cazo de se fazerem seria bom que fosse prezentes os edificios e renovadas as medições, para se fazer correcção em algumas de que tenho noticia necessitão della, pois nem sempre as principaes pessoas as prezenciavão.

13.º O Sennado de Lisboa que já cultivou esta materia nas ruas dos ourives da prata, e do ouro, e dos douradores, não achou melhor meyo q̃ tomar a si as cazas avaliadas que queria emmendar, e fazendo a obra á sua custa, vendel-as a quem mais déce, para satisfazer aos credores; e poderá ser q̃ avaliados os edificios destruidos de huma freguezia, e formados os edificios novos da mesma, e postos depois em venda, possa o seu producto satisfazer assim o valor dos edificios destruidos, como a obra dos edificios novos: e como a Cidade baixa destruida, se não pode reedificar toda ao mesmo tempo, parecia justo que a experiencia se fizesse em huma de suas partes, que poderia ser em parte da freguezia de S. Julião no sitio incluzo entre a rua dos ourives do ouro e a rua nova do Almada, por haver nelle muitos beccos e ruas estreitas q̃ he onde pode haver a mayor duvida —, advertindo parecer conveniente que o Sennado determinace os arruamentos, para que segundo elles se formassem logo os edificios com os commodos proporcionados.

14.º As duas renovações mais celebres das Cortes da Europa, tem sido a de Londres, e a de Turim; e dezejando eu saber o como se procedêo com os particulares na sua execução, sem ter Livro de que me valer, nem Bibliotheca publica q̃ nunca mais preciza me pareceo que na prezente occaziãn, nem occaziãn mais propria para se lhe dar principio que esta, ainda q̃ não seja logo tam numeroza como hoje são as mayores q̃ não principiarão tão grandes, me achey obrigado a mendigar huma historia de Inglaterra que incluice o anno de 1666 em q̃ não consegui noticia de proveito; e vendo no Diccionario Geografico de Martiniere a descripção de Londres, em que lhe delinea as ruas como as nossas da Villa de Thomar, tambem não achey nelle clareza de que me service; o que poderia conseguir se tivesse mais q̃ revolver. A renovação da Corte de Turim, não he como alguns dizem, q̃ fora arrazando Turim Velho, para fazer Turim novo, porque só foi acrescentar Turim novo a Turim velho, fazendo em hum sitio plano contiguo a Turim, hum aditamento a Turim, no que não havia difficuldade que vencer; donde venho a concluir q̃ a renovação de Lisbôa destruida tem muito mais que ponderar que o augmento da de Turim acrescentada.

O que resta ainda determinar he se as ruas mais principais se devem dividir em tres partes como as de Inglaterra; e se se hão de fazer porticos, ou columnatas em algumas ruas como havia na rua nova dos ferros, e na Confeitaria: sobre o que me parece dizer q̃ nas obras do terreiro do Paço as columnatas serão de bom uzo, e bom adorno, mas que nas ruas de logeas me parece mais conveniente que não haja columnatas e que as antigas da rua nova dos ferros servirão aos homens de negocio por falta do edificio da bolça, q̃ fazendo-se no terreiro do Paço como espero, he escuzado suplemento em outra parte; declaro q̃ as ruas de Inglaterra são formadas de trez divizões, a do meyo mais larga para as carroagens, e as duas dos lados para a gente de pé; aquella calçada de pedra miuda, e as duas de enchelharias groças com seus postes que as separão da do meyo, para que as carroagens não vão embaraçar os dous passeyos; as principais são de larguras excessivas, o que nós poderiamos suprir com quarenta e cinco ou cincoenta palmos de largo, dando dez palmos a cada hum dos dous passeyos, ficando o resto no meyo para uzo das carroagens: mas não me inclino a esta divizão de ruas, porque nas occaziões de festas, e de concurços, se não poderão concervar bem em seu estado proprio, não sendo de huma largura muito mayor, o que no grande comprimento de algumas ruas de Inglaterra se faz mais adequado, e na nossa Cidade de Lisbôa baixa destruida consumirá muito terreno, em prejuizo dos donos dos edificios que obrigados a não levantar mais q̃ dous pavimentos sobre as logeas, clamarão contra a maior largura das ruas do que as tres divizões serão cauza.

Na planta n.º 4.º apresento mais huma renovação da cidade baixa arruinada expressada pello Ajudante Pedro Gualter da Fonseca com toda a liberdade possivel, sem attender á conservação dos sitios das Igrejas Parroquiais para no cazo de não servir de embaraço a tal mudança possa também entrar na conta dos pensamentos ponderados.

15.º Em 5.º lugar offereço a planta de huma rua de 60 palmos de largo á imitação de algumas da de Londres dividida em tres partes, a do meyo de 40 palmos de largo para carroagens, e gente de cavalo, e as duas dos lados de dez palmos de largo cada huma para a gente de pé e Cadeirinhas, com a separação de pilares e pavimento que o profil mostra, e no mesmo profil a figura da Cloaca, ou Cano Real para serventia das agoas dos montes e limpeza dos conductos, que dos edificios se lhe introduzem.

16.º Em 6.º lugar offereço o primeiro prospecto em que se mostra a altura e simmetria dos edificios com dous pavimentos sobre as logeas com janelas rasgadas no primeiro, e com janelas de peitoris no segundo, e divizões de paredes altas sobre os telhados para deffensa da communicação dos incendios.

17.º Em 7.º lugar offereço o segundo prospecto em que se mostra a altura e simmetria dos edificios com dous pavimentos sobre as logeas, ambos de janelas rasgadas, e com divizões de paredes altas para deffensa da communicação dos incendios.

18.º Em 8.º lugar offereço o 3.º prospecto em que se mostra a altura e simmetria dos edificios, com seus porticos, ou columnatas, contra as inclemencias do tempo com dous pavimentos sobre as logeas, e ambos de janelas rasgadas, e divizões de paredes altas sobre os telhados para impedimento dos incendios.

19.º Em 9.º e ultimo lugar offereço huma forma de edificio mais nobre para o Terreiro do Paço com seus porticos com mezaninos contra as inclemencias do tempo, dous pavimentos de janelas rasgadas (dos quais hum se poderá abater parecendo grande a altura) e outro pavimento de mezaninos junto aos telhados; e divizões de paredes altas para deffensa da communicação dos incendios; e todas estas sinco ultimas reprezentações são expressadas pello Capitão Eugenio dos Santos e Carvalho.

E he quanto me foi possivel unir nesta 3.ª parte, guardando o restante para a quarta. Lx.ª 31 de março de 1756.

ADDITAMENTO

Em decimo lugar offereço a planta n.º 5 p.ª a renovação da cidade de Lisbôa baixa arruinada sem attenção á conservação de sitios de templos ideada pello Cap.º Eugenio dos Santos e Carvalho na qual a cor amarela mostra o que se fará de novo, e o vermelho o que se conserva do antigo.

Em undecimo lugar offereço a planta n.º 6.º p.ª a renovação de Lisbôa baixa arruinada sem attender á conservação dos sitios antigos, ideada pelo Capitão Elias Sebastião Pope. Lx.ª 19 de abril de 1756. = *Manuel da Maya.*

1.2 Alvará De 12 De Maio De 1758

Alvará que estabelece os direitos publicos e particulares da reedificação da Cidade de Lisboa, e os beneficios ás pessoas que para ella concorrerem com dinheiro, materiaes ou mão de obra.

Eu ELRey faço saber aos que este Alvará com força de Ley virem, que contemplando a grande ventagem, que seria para os meus Reinos, e Estados a reedificaçaõ da Capital delles por hum novo plano regular, e decoroso: Houve por bem resolver, que a Cidade de Lisboa fosse promptamente reedificada com os limites declarados no meu Real Decreto de 5 de Dezembro do anno de 1755, para que nos Bairros, cujos edificios foraõ abrazados, e demolidos, se allinhem as Ruas com a rectidaõ, e largura competentes à commodidade dos seus habitantes, e ao serviço dos que por ellas passaõ; e que nos outros Bairros, cujos edificios ficaroã no estado de admittirem concerto, se melhorem as Ruas aos ditos respeitos, quanto possivel for. E para que huma obra taõ util, e necessaria ao Bem Commum, nem padeça as demoras, que nella seraõ intolleraveis, nem se faça com prejuizo dos particulares, que seja attendivel: Sou servido ordenar o seguinte.

1 Assim nos referidos Bairros, cujos edificios foraõ abrazados, e demolidos, como nos terrenos das casas dos outros Bairros, que foraõ inteiramente arruinadas; querendo os donos dos respectivos solos edificar na conformidade do sobredito plano; e obrigando-se efficazmente a darem as obras acabadas no termo de cinco annos, successivos, e contados do dia, em que assinarem a obrigaçaõ, o poderáõ livremente fazer. E sendo os ditos terrenos enfyteuticos, preferiráõ neste direito de edificar os enfyteutas dos prazos aos senhores directos delles.

2 Não querendo porém, ou naõ podendo os donos dos referidos terrenos edificar na sobredita fórma, no caso de serem as propriedades deles allodiaes, se adjudicaráõ pelos Ministros, que Eu for servido nomear para este effeito, às pessoas que se obrigarem a edificar na mesma conformidade, e dentro no referido termo: pagando aos donos dos terrenos o justo valor delles, e dos materiaes, que nelles se acharem: sendo tudo avaliado com assistencia dos respectivos Ministros, e citaçaõ das partes, por Louvados nomeados na fórma de Direito, e do costume praticado em semelhantes casos: e preferindo sempre para edificarem os visinhos confrontantes das respectivas propriedades.

3 Quando as mesmas partes se considerarem gravadas nas avaliações dos bem allodiaes, e enfyteuticos, que se fizeram na sobredita fórma, excedendo a propriedade o

valor de trezentos mil reis no juizo dos Louvados, ou conforme o parecer de algum delles, recorreráõ à Casa da Supplicaçaõ com o processo verbal do arbitramento, de que interpozerem o recurso, o qual será nella tambem verbalmente julgado pelos Juizes, e Adjuntos, que nomear o Regedor; preferindo sempre o despacho dos sobreditos recursos à expediçaõ de todo, e qualquer outro negocio; sem que com tudo se suspenda, em quanto os taes recursos se julgarem, na edificaçaõ, où reedificaçaõ, que se houver de fazer nos terrenos, de cujas avaliações se tratar.

4 Nas edificações, e reedificações, que se fizerem nas propriedades sujeitas a Morgados, ou Capellas, preferiráõ sempre semelhantemente os respectivos Administradores, para fazerem por sua conta as referidas obras, parecendo-lhes, e podendo a isso obrigarse na sobredita fórma. Porém quando elles naõ quizerem, ou naõ puderem obrigarse efficaz, e effectivamente, se adjudicaráõ os terrenos das taes propriedades a outras pessoas, que queiraõ, e bem possaõ obrigarse a edificar na conformidade dos respectivos planos, e dentro do referido termo de cinco annos: com tanto, que ao mesmo tempo se obriguem a pagar aos Administradores dos Morgados, e Capellas, a que os terrenos pertencerem, a título de Prazo fateozim perpetuo, com o laudemio de vintena, a pensaõ annua, que lhes for imposta por arbitrio da Mesa do Desembargo do Paço: e que lhes façaõ titulo nesta conformidade, no caso de naõ haver renitencia da parte dos sobreditos Administradores; porque havendo-a, ficaráõ as adjudicações, que se fizerem dos taes terrenos, servindo de titulos communs.

5 Porque ao mesmo tempo podem concorrer muitas pessoas a querer edificar em hum só terreno vinculado, estabeleço, que neste caso fique livre aos Administradores dos Morgados, ou Capellas, darem a preferencia ao que melhor lhes parecer entre os dous visinhos confrontantes, que o forem ao tempo, em que se tratar da preferencia. E naõ concorrendo visinho confrontante, poderáõ preferir qualquer outra pessoa, que lhes seja mais grata: bem visto, que em qualquer destes dous casos haõ de ser os emprazamentos approvados pela Mesa do Desembargo do Paço na sobredita fórma: e que em quanto à natureza dos Prazos, e quantidade das pensões annuas, e laudemios, naõ poderáõ os Administradores alterar por algum modo o que tenho acima ordenado.

6 Considerando, que naõ seria conforme à equidade natural, que os proprietarios dos terrenos, que haõ de ficar sitos nas Ruas, que devem allinharse com a rectidaõ, e largura, que tenho estabelecido, recebendo os beneficios do menos perigo nos terremotos, e incendios, da mayor claridade da luz, da mayor liberdade do ar, da mayor facilidade nas conduções, da mayor frequencia na passagem, e do mayor valor, que por todas estas ventagens, e pelos privilegios abaixo declarados, ha de accrescer às suas propriedades, assim na estimação dos capitaes dellas, como nos alugueres; se locupletem com o prejuizo dos outros proprietarios, cujos terrenos se haõ de devassar para serem incluidos nas taes Ruas: Mando, que estes terrenos perdidos sejaõ avaliados na sobredita fórma: que o total valor delles seja rateado pelas varas das frentes dos dous lados de cada huma das sobreditas Ruas: e que seja pago repartidamente pelos primeiros dos referidos proprietarios, pagando cada hum delles a favor dos segundos a proporçaõ das varas, que tiverem as frentes dos seus respectivos edificios.

7 Achando-se, que os referidos terrenos perdidos pertencem a Capellas, ou Morgados, se porá o seu valor em deposito para se empregar em bens capazes de nelles

subsistirem os vinculos. O mesmo se praticará a respeito dos terrenos, que já saõ enfyteuticos, para que com o preço delles sejaõ inteirados os respectivos Prazos.

8 Fazendo-se porém de novo alguma Praça publica, ou ampliando-se as que hoje existem, naõ seraõ os particulares donos das propriedades, que presentemente estaõ situadas nas mesmas Praças, e que nellas ficarem conservadas, obrigados a pagar cousa alguma pelos terrenos, que para a sua ampliaçaõ se comprarem, os quaes seraõ avaliados na sobredita fórma, e pagos a seus donos conforme as Providencias, que Eu for servido dar, segundo a exigencia dos casos.

9 Para que não haja demoras nem nas sobreditas avaliações, nem nas eleições das pessoas, que houverem de ser preferidas para edificarem, por falta de assistencia das partes interessadas, ordeno que estas sejaõ notificadas por Editos, ou a bem da Justiça para as avaliações, ou à instancia das pessoas, que pretenderem edificar no terreno livre, ou vinculado; para que per si, ou por seus bastantes procuradores venhaõ as sobreditas partes assistir à avaliaçaõ, ou declaraçaõ das pessoas, de que fazem eleição; a saber, achando-se presentes na Cidade de Lisboa, ou no Termo della dentro de dez dias; e achando-se ausentes dentro de trinta dias, todos contados continua, e successivamente; com pena de que, findos elles, se procederá à revelia, na maneira acima declarada.

10 Para mais facilitar os meyos necessarios de beneficiar os meus vassallos, com as ventagens, que a todos elles se haõ de seguir das sobreditas edificações, ou reedificações, estabeleço, que as pessoas, que emprestarem dinheiro, ou concorrerem com materiaes, ou mãos de obreiros para se edificar, ou reedificar dentro do recinto da Cidade de Lisboa, que foy expresso no meu sobredito Decreto de 3 de Dezembro do ano proximo passado, fiquem naõ só com Real Hypotheca em concorrente quantia nos edificios, ou bemfeitorias, que nelles se fizessem em todo, ou em parte; mas tambem com preferencia a todos, e quaesquer outros credores ainda hypothecarios, que fizerem penhoras posteriores às edificações, ou reedificações, como se os mutuantes tivessem penhoras filhadas anteriores, e feitas em execução de sentenças havidas em Juizo contencioso com plenario conhecimento de causa: o que se executará, posto que os outros credores sejaõ privilegiados, ainda que seja a minha Real Fazenda; porque a todos os outros privilegios ordeno, que se prefira sempre o dos sobreditos mutuantes.

11 Formando-se concurso sobre os bens de qualquer reedificante, ou edificante, o Juiz deste concurso, conhecendo breve, e summariamente da verdade da divida procedida da edificaçaõ, ou reedificaçaõ total, ou parcial, faça logo pagar ao credor della pelo producto das logens, casas, ou armazens reedificados, eximindo-o assim da longa disputa dos mais preferentes, e de esperar a final decisão de todo o concurso ordinario.

12 Determino, que havendo de ter administraçaõ ordinaria, ou extraordinaria a pessoa, casa, ou bens do que houver tomado de emprestimo, e empregado dinheiro na sobredita *fórma*, naõ possaõ ter os taes edificios, e bemfeitorias, que com elle se fizerem, outro administrador, que naõ seja o mesmo credor, que houver feito o emprestimo, ou concorrido com os seus materiaes, ou mãos de obreiros: ao qual credor será dada neste caso a administraçaõ dos referidos edificios, e bemfeitorias, para por elles, ou por ellas haver seu pagamento, debaixo da obrigaçaõ de dar contas a Juiz competente dos rendimentos das casas, que tiver na sua administraçaõ, e do que pelos productos dellas embolçar annualmente até o seu inteiro pagamento.

13 Contemplando especialmente ao mesmo tempo sobre as grandes despesas, a que haõ de ser obrigados os proprietarios dos terrenos, e casas, que fizerem as sobreditas edificações, ou reedificações, em beneficios da utilidade publica, e do decoro da Capital dos meus Reinos, o muito que importa favorecer Eu, quanto possivel for, o Commercio, as manufacturas, e as pessoas, que nelle, e nellas se empregaõ: Sou servido eximir absoluta, e perpetuamente de aposentadoria activa, e passiva as Praças, e Ruas, que tenho destinado para bolça do Commercio, e para habitaçaõ dos Homens de negocio, Mercadores, e Traficantes, que nelle se empregaõ, as quaes saõ as seguintes: nos Bairros de Alfama, do Limoeiro, da Rua Nova, e do Rocio, tudo o que jaz das Portas do Chafariz de dentro, até S. Pedro de Alfama; desta Igreja até a de S. Joaõ da Praça; della pelas Cruzes da Sé, e pelo Arco da Consolaçaõ, até à Igreja da Magdalena; com tudo o mais, que está situado da Rua das Pedras Negras, até o Beco, que sahe defronte da Igreja dos Torneiros; do largo, que fica por detraz da Igreja de S. Nicoláo; da Rua das Arcas, até a extremidade meridional do Rocio; e della pelas Ruas dos Escudeiros, e dos Odreiros, até à Calcetaria. Nos referidos Bairros do Rocio, Rua Nova, e no dos Remolares, tudo o que jaz da boca da Rua Nova do Almada, do largo da Santa Igreja Patriarcal, da Porta da Campainha, da Tanoaria, do Corpo Santo, da Cruz de Catequefarás, do largo de S. Paulo, da Boa-Vista, do Poço dos Negros, e da Esperança para a mesma banda do mar; incluindo-se sempre ambos os dous lados das referidas Ruas em todos os terrenos acima declarados. O mesmo se observará nos arruamentos, que Eu for servido determinar para habitaçaõ dos Artifices no Plano da Cidade acima referido. Porém nos outros Bairros, e Ruas, que naõ forem do Commercio, e dos arruamentos dos Artifices, mas da habitaçaõ dos outros moradores sómente se observará o sobredito privilegio de isençaõ de aposentadoria por tempo de trinta annos a favor dos proprietarios daquelles edificios, que forem, ou de novo edificados, ou reedificados desde os fundamentos.

Pelo que mando ao Presidente da Mesa do Desembargo do Paço, Védores da Fazenda, Regedor da Casa da Supplicaçaõ, Governador da Relaçaõ, e Casa do Porto, e Ministros, Officiaes, e Pessoas destes Reinos, que cumpraõ, e guardem, e façaõ inteiramente cumprir, e guardar este meu Alvará, como nelle se contém, sem embargo de quaesquer outras Leys, ou Disposições, que se opponhaõ ao conteúdo nelle, as quaes hey por derogadas para este effeito sómente, ficando aliás sempre em seu vigor. E mando ao Desembargador Manoel Gomes de Carvalho do meu Conselho, Chanceller mór do Reino, que faça publicar este na Chancellaria, e remetello aos lugares onde se costumaõ remetter, registando-se nos livros onde se registaõ semelhantes Leys, e mandando-se o original para a Torre do Tombo. Escrito em Belem a 12 de Mayo de 1758. = REY. = Sebastiaõ Joseph de Carvalho e Mello.

1.3 Interpretation by the Author of the Alvará De 12 De Maio De 1758, (Licence of the 12th May 1758).

i) Guidelines for the redistribution of land for building

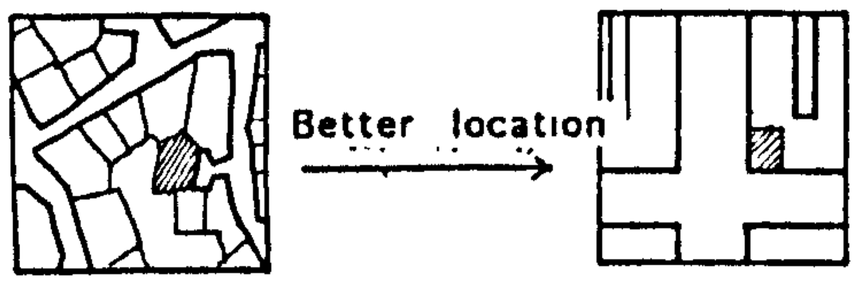
In order to easily overcome obstacles that might arise in trying to relate old to new properties, Manuel da Maia drew up the following guidelines:

a)-Each case had to be observed on site because it was difficult to define measurements exactly from available plans of Lisbon.

b)-Apportionment of land in the new proposals was to be based on the proportion of total area of destroyed buildings to the total area of new buildings.

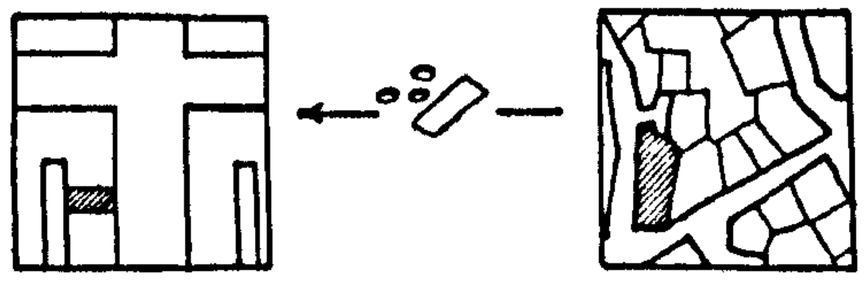
c)-The advantages of wider streets should be impressed on the owners especially those who had owned property in the old narrow streets, in order to persuade them to accept smaller building areas in the new proposals (see Fig.1.1).

Figure 1.2



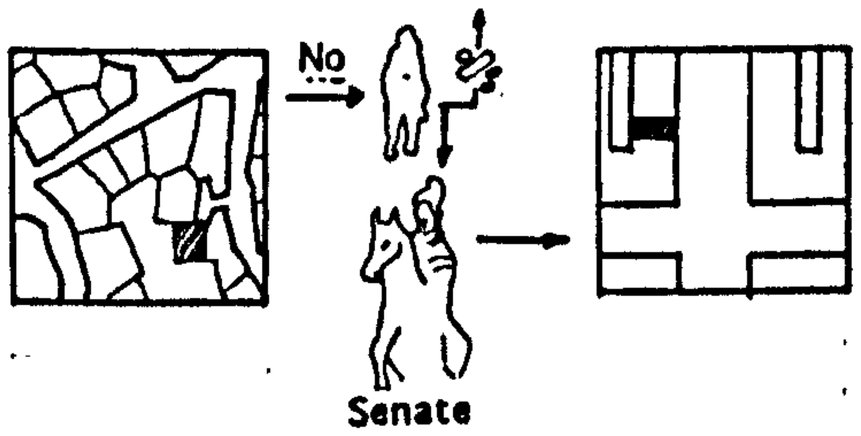
d)-Where the areas attributed to an owner, in the new plan, were less than those derived from the proportion described above, they were substituted by other sites or, if owners were not satisfied with this, by monetary compensation (see Fig.1.3).

Figure 1.3



e)-In cases where the previous owners declined to accept the equivalent buildings in the new proposals, the Lisbon Senate should undertake the rebuilding at its own expense, selling them to the highest bidder. The income thus generated would be set against the value of the destroyed buildings as well as the cost of the new ones (see Fig.1.4).

Figure 1.4



ii) Indications of how to solve bureaucratic problems and to encourage construction

In this licence the king made public that he considered of great importance, the private and public rights to the reconstruction of the Capital city by means of an elegant and regular plan. Also to avoid any intolerable delay he established that:

f)- The city could be rebuilt at once within the limits defined by the *Cerca*,

(see Fig.1.5).

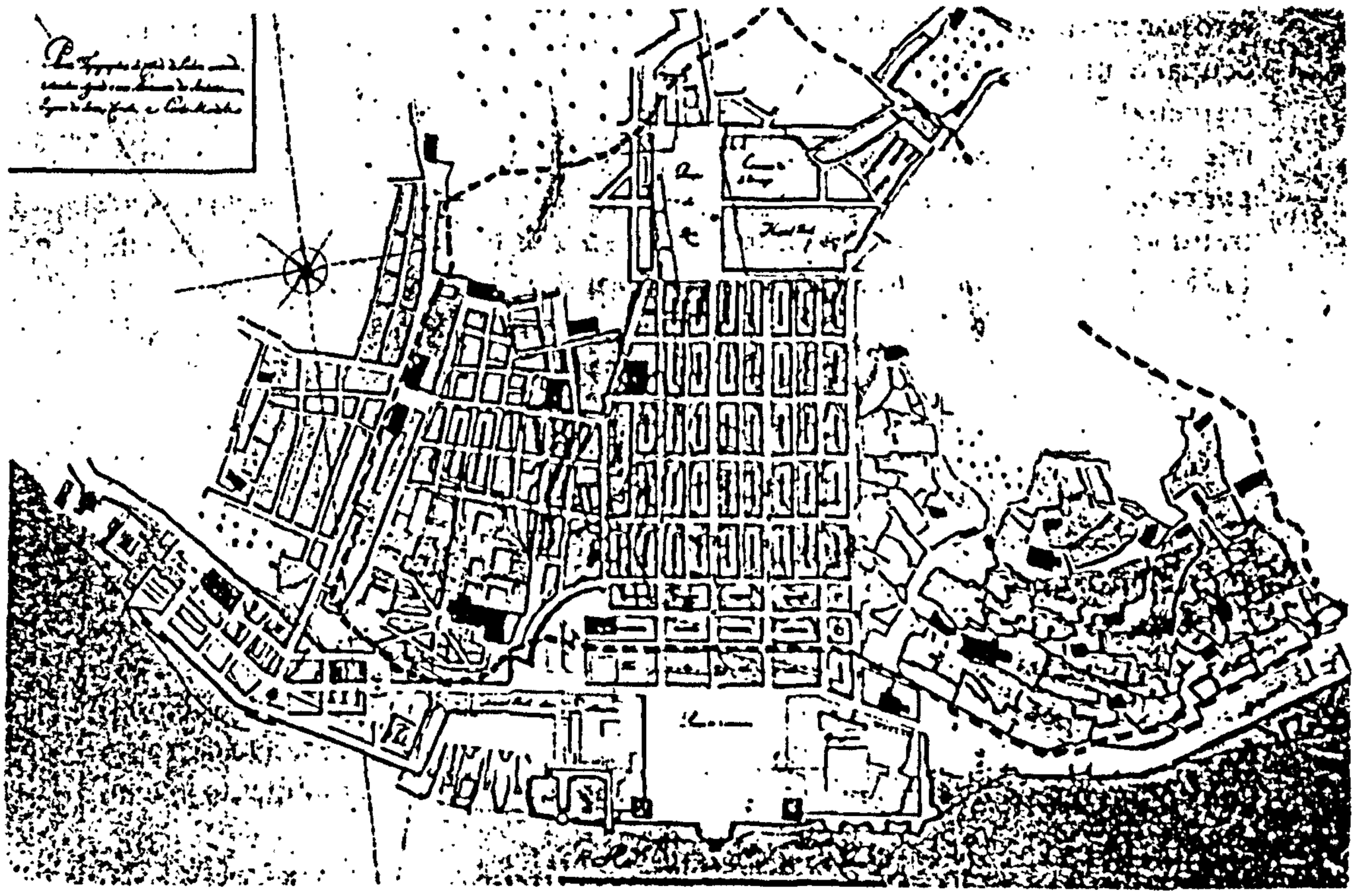


Fig.1.5-The plan and the *Cerca*

g)-The individuals who had participated in the reconstruction with money, materials or labour were given preference over any other parties in property disputes.

h)-In the areas where it was possible to rehabilitate buildings the streets were to be widened, (see Fig.1.6).

i)-In other areas where buildings had crumbled, the new streets were planned straight to provide greater convenience.

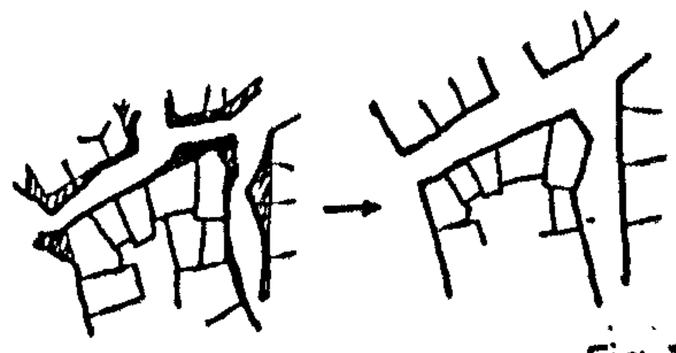


Fig.1.6

j)-The land owners wishing to build on their own were required to have this work completed within a five-year time period, counted from the date of completion and legitimisation of the contract, (see Fig.1.7).

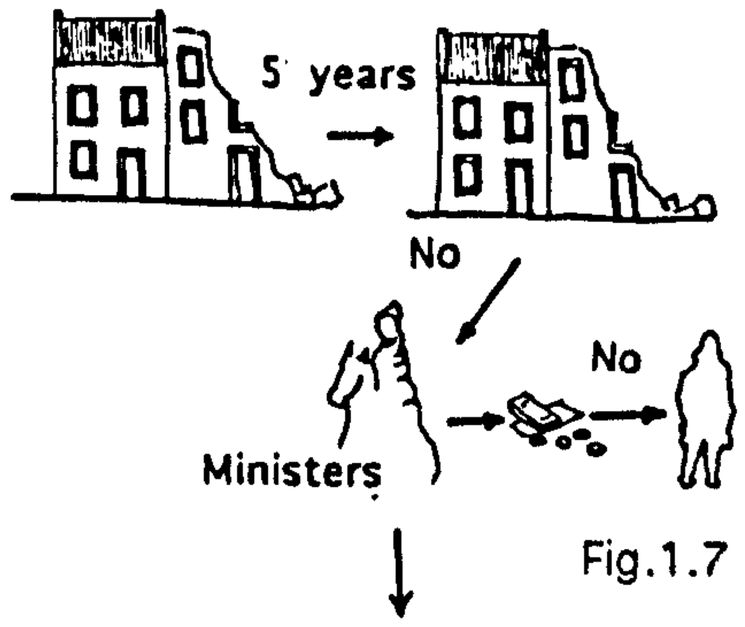


Fig.1.7

k)-If an owner was unable to build under the established conditions, the case could be adjudicated by the Ministers expressly nominated for that purpose and the owner would receive only the value of the land plus that of the materials. As customary in such cases the adjoining owners were given a preferential option to purchase the land. Only the landlord of properties worth over 300 thousand Reis could appeal to the Casa da Suplicação, (court) when he considered that the lease was wrongly valued attributed by the Ministers (see Fig.1.8).

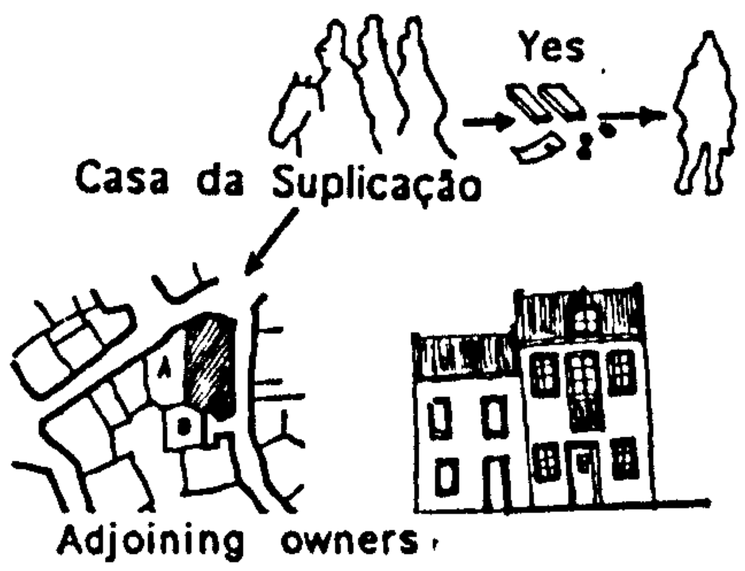


Fig.1.8

l)-Owners with properties served by new streets, with additional benefits such as ventilation, lighting, location and a greater volume of traffic which increased the real value of the property, had to compensate others whose lands were expropriated to allow construction of new streets (see Fig.1.9).

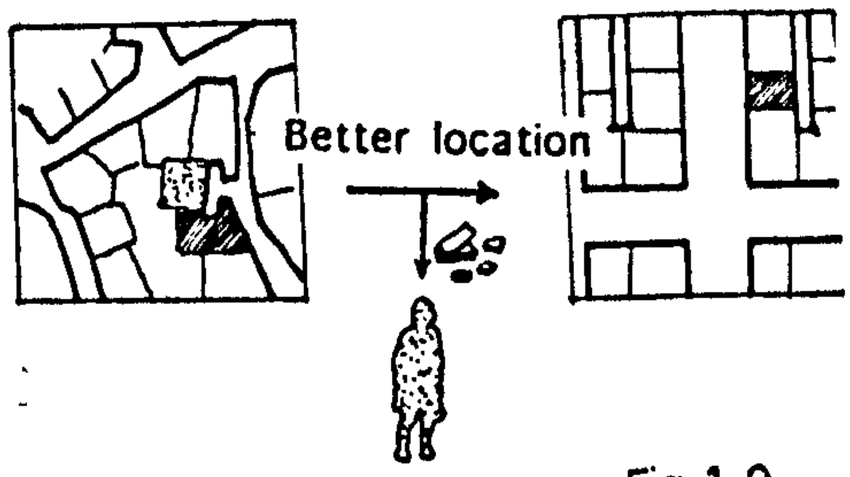


Fig.1.9

m)-In order not to delay in receiving bidders or evaluations it was ordered that the interested individuals should be notified by public notices to be present in the City Conservatory within 10 days, or 30 days in case of their being away from the city. If they were not present, decisions in default were made.

n)-When loans were granted towards reconstruction or improvement of a building, the loan could only be administered by the creditor, who must report annually to the judge, on the profits obtained during administration until the full payment of the debt, (see Fig.1.10).

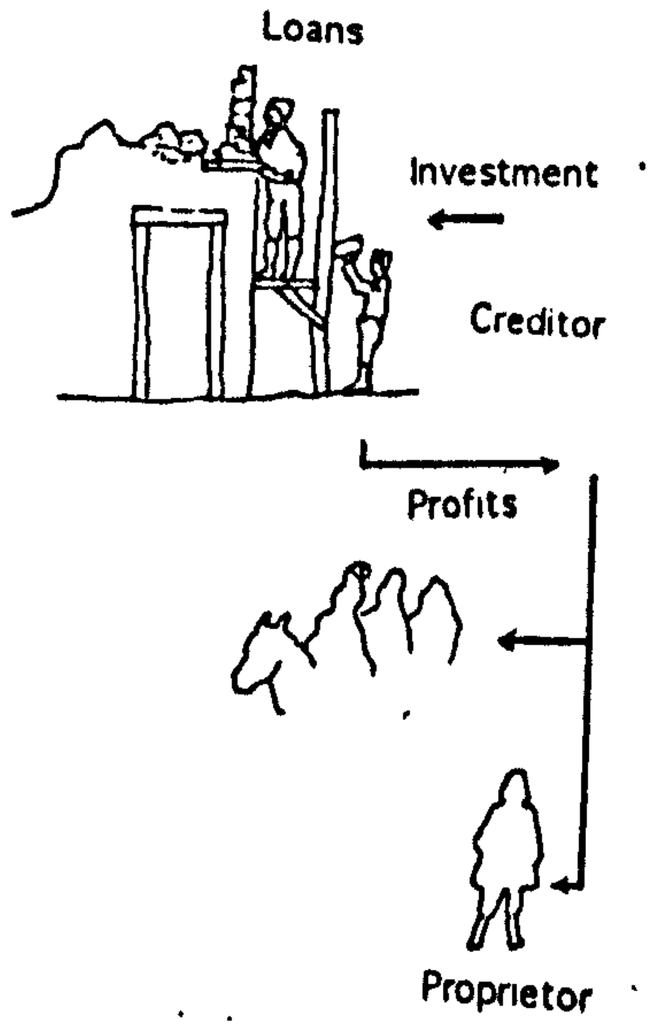


Fig.1.10

Appendix 2 - A photographic record of buildings studied during the research.

2.1 Photographs of the Pombaline area, its streets and its buildings.

2.2 Photographs of other contemporary Pombaline developments at Vila Real, Porto Covo and Manique do Intendente.

This appendix mainly consists of a photographic record of the buildings and streets which make up the Pombaline area. Most of these buildings have been surveyed by the author and many of the streets shown are referred to in the main text of the thesis. The appendix also includes other contemporary Pombaline developments. The photographs therefore form a useful record of the state of the buildings at the current time. All the photographs were made by the author.

List of photographs

2.1 Photographs of the Pombaline area, its streets and its buildings.

2.2 Photographs of other contemporary Pombaline developments

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Photograph 2.57-Houses of the square, detail of the roof.
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Photograph 2.60-The square.
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Manique do Intendente
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2.1 Photographs of the Pombaline area, its streets and its buildings.

Photograph 2.1 -Pombaline area, partial view, from S. Francisco.

Photograph 2.2 -Rossio Square, from S. Francisco hill.

Photograph 2.3 -Rossio Square, partial view.

Photograph 2.4 -Betesga Street.

Photograph 2.5-Figueira Square.

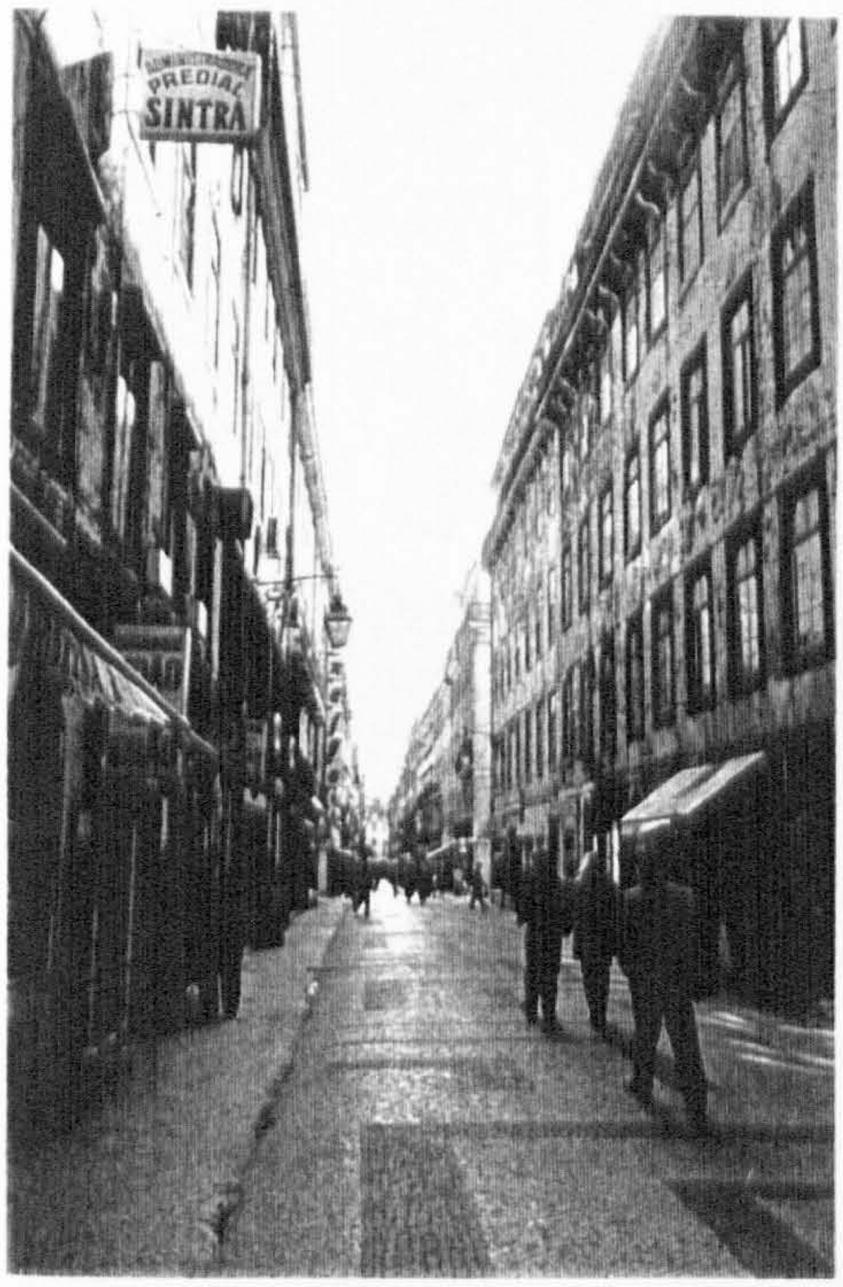
Photograph 2.6-Ouro Street 1

Photograph 2.7-Ouro Street 2

Photograph 2.8-Sapateiros Street.

Photograph 2.9-Augusta Street.

Photograph 2.10-Correeiros Street 1



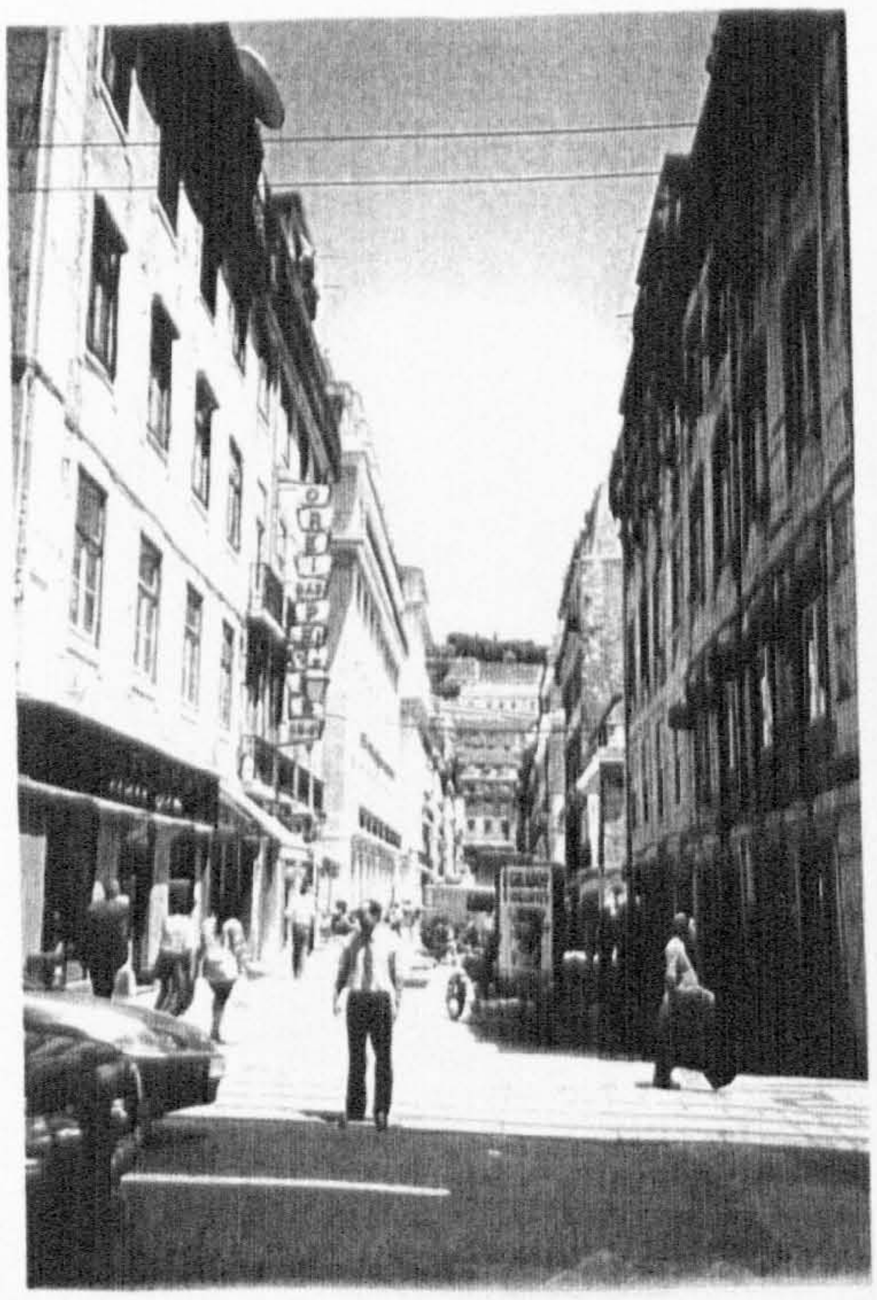
Photograph 2.11-Correeiros Street 2

Photograph 2.12-Prata Street.

Photograph 2.13-Douradores Street.

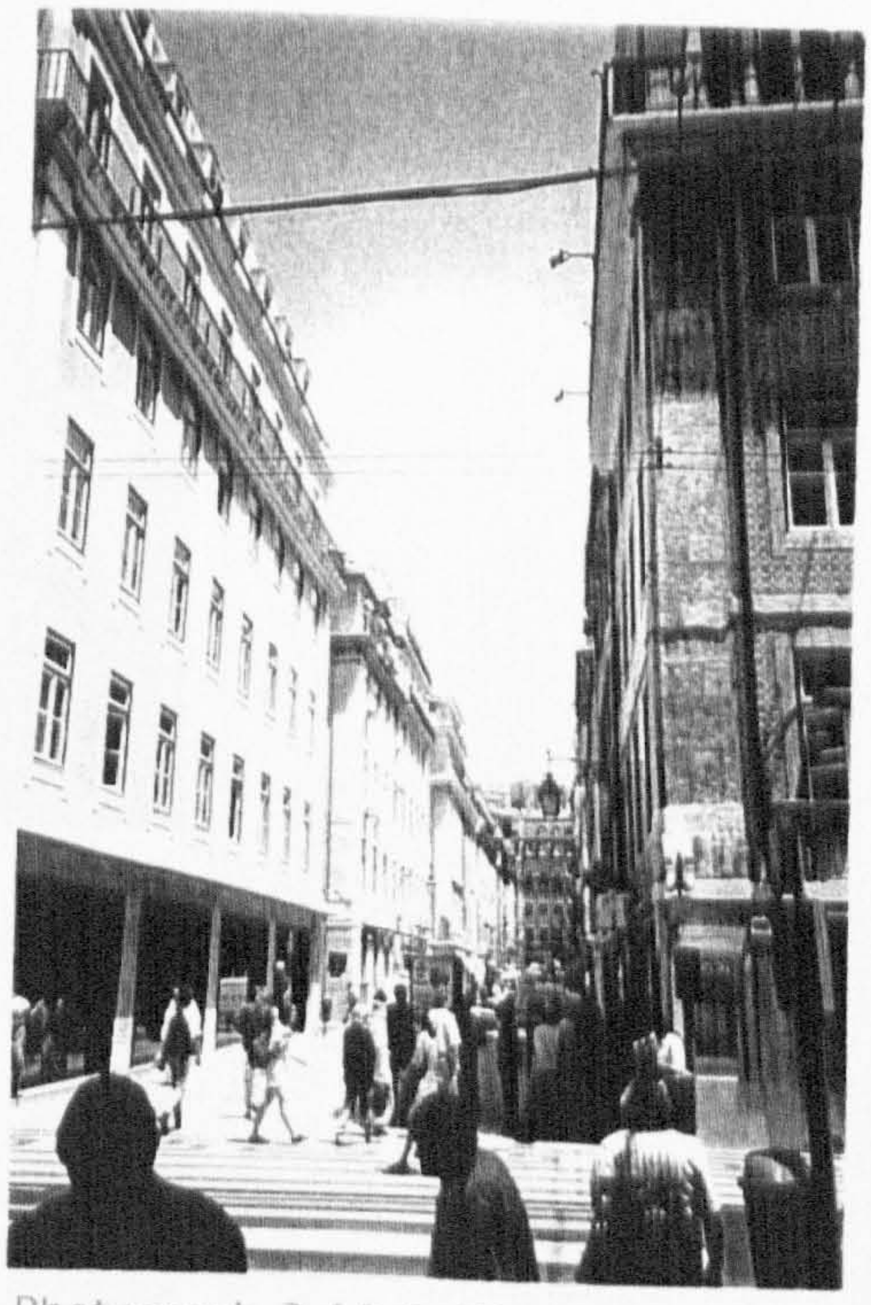
Photograph 2.14-Fanqueiros Street.

Photograph 2.15-Santa Justa Street.



Photograph 2.16-Assunção Street.

Photograph 2.17-Vitória Street.



Photograph 2.18-S. Nicolau Street

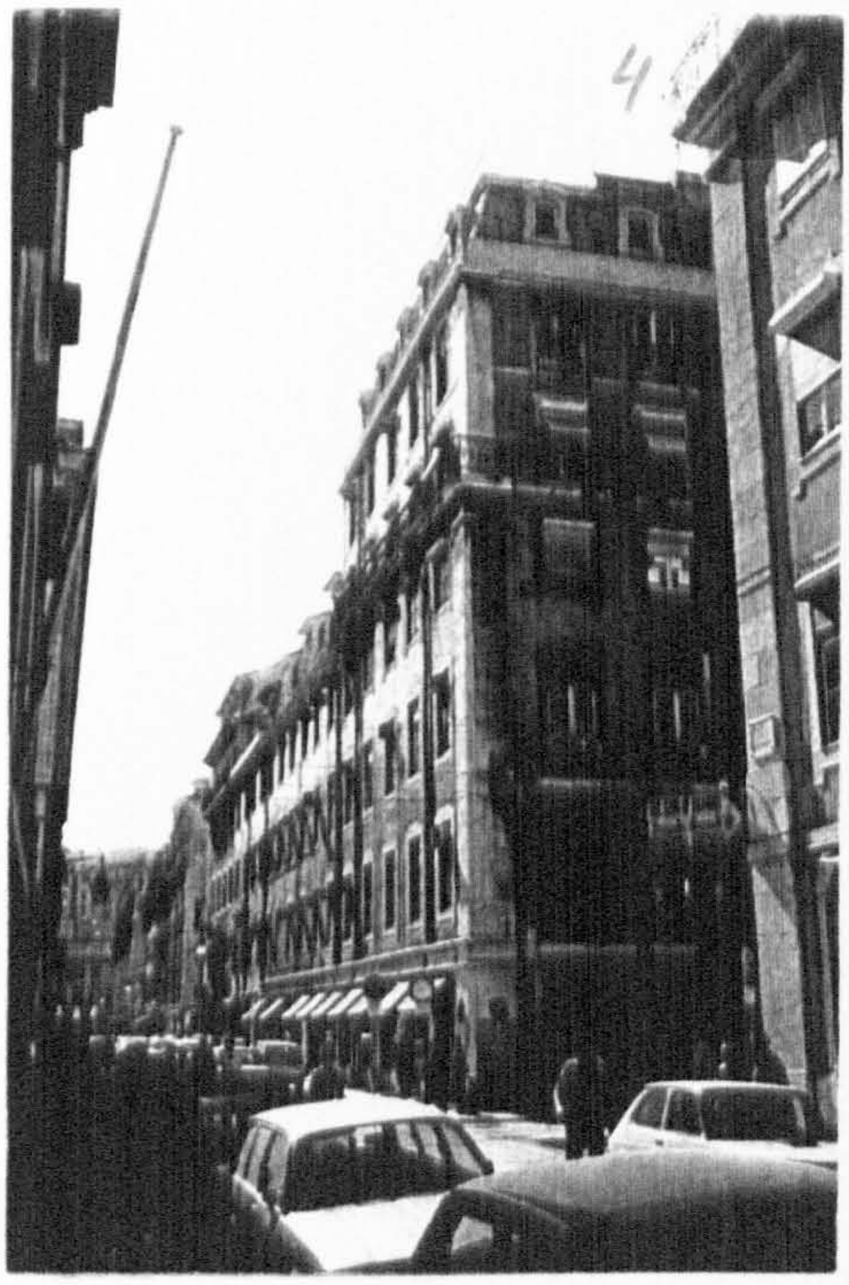
Photograph 2.19-Conceição Street

Photograph 2.20-S. Julião Street.

Photograph 2.21-Comércio Street.

Photograph 2.22-Arsenal Street.

Photograph 2.23-Corner, Conceição and Prata Streets.



Photograph 2.24-Corner, Prata and S. Nicolau Streets.

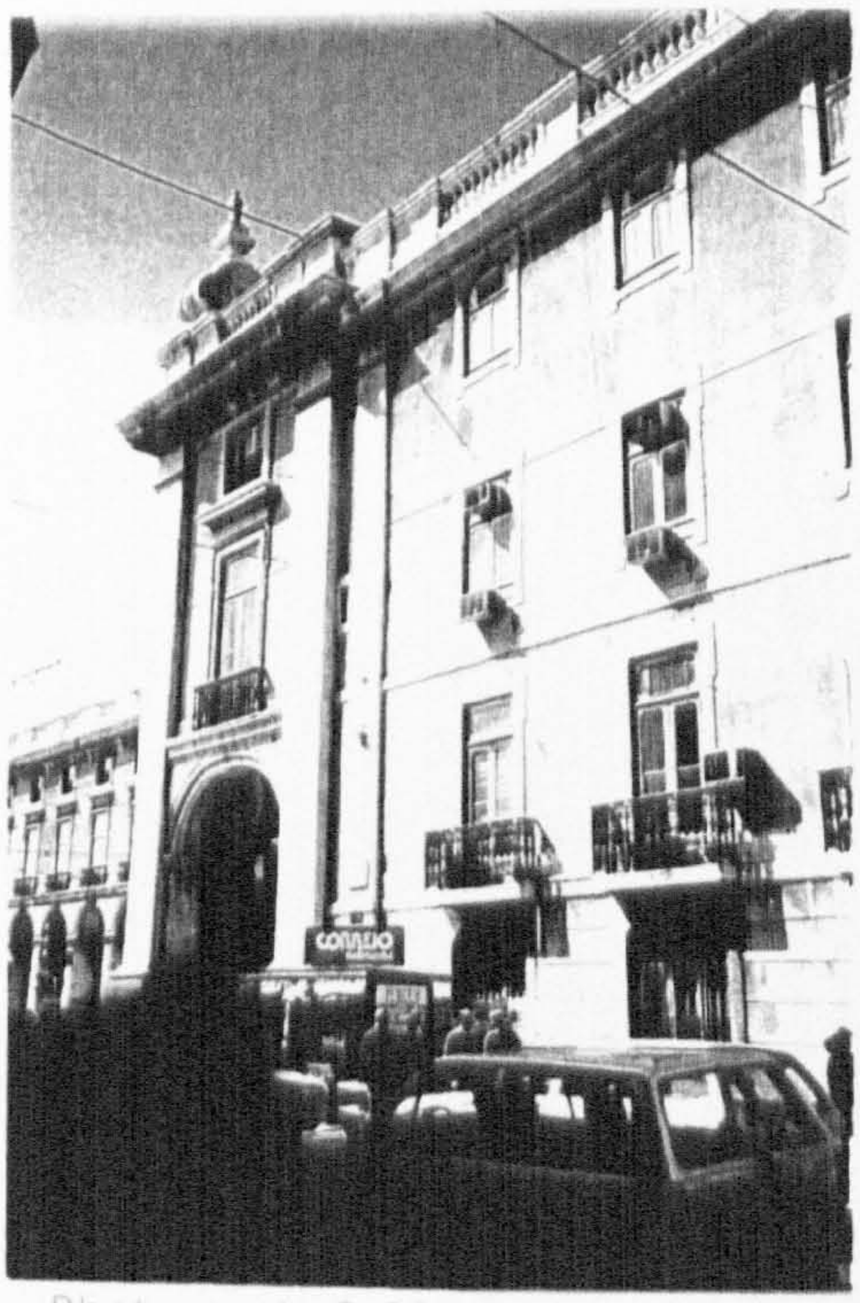
Photograph 2.25-A building on Rossio Square

Photograph 2.26-Corner, Ouro and Santa Justa Streets.

Photograph 2.27-Corner, Arsenal and Corpo de Deus Square

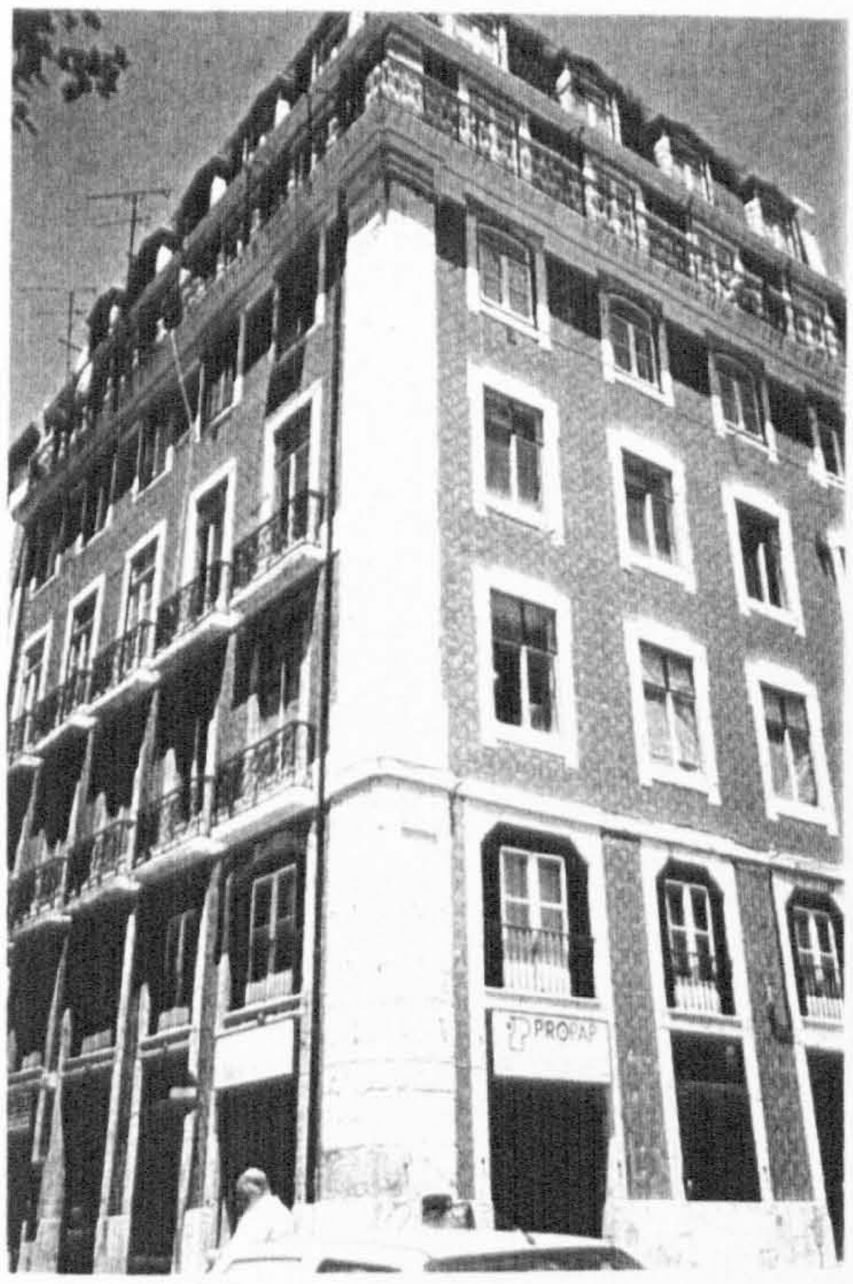
Photograph 2.28-Municipio Square.

Photograph 2.29-Building at Vitória Street.



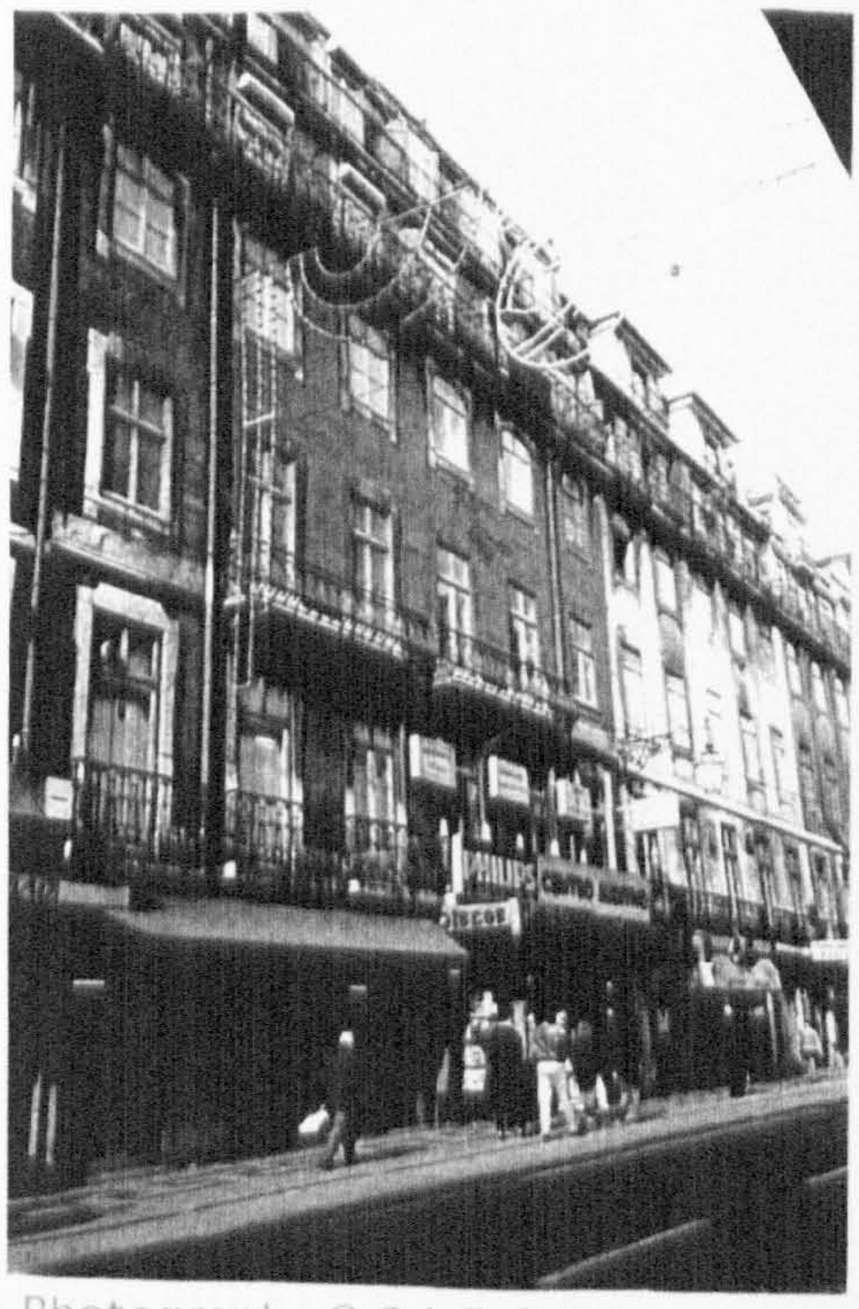
Photograph 2.30-Ouro Street, near Comércio Square.

Photograph 2.31-Building at Douradores Street.



Photograph 2.32-Corner, Santa Justa and Douradores Streets

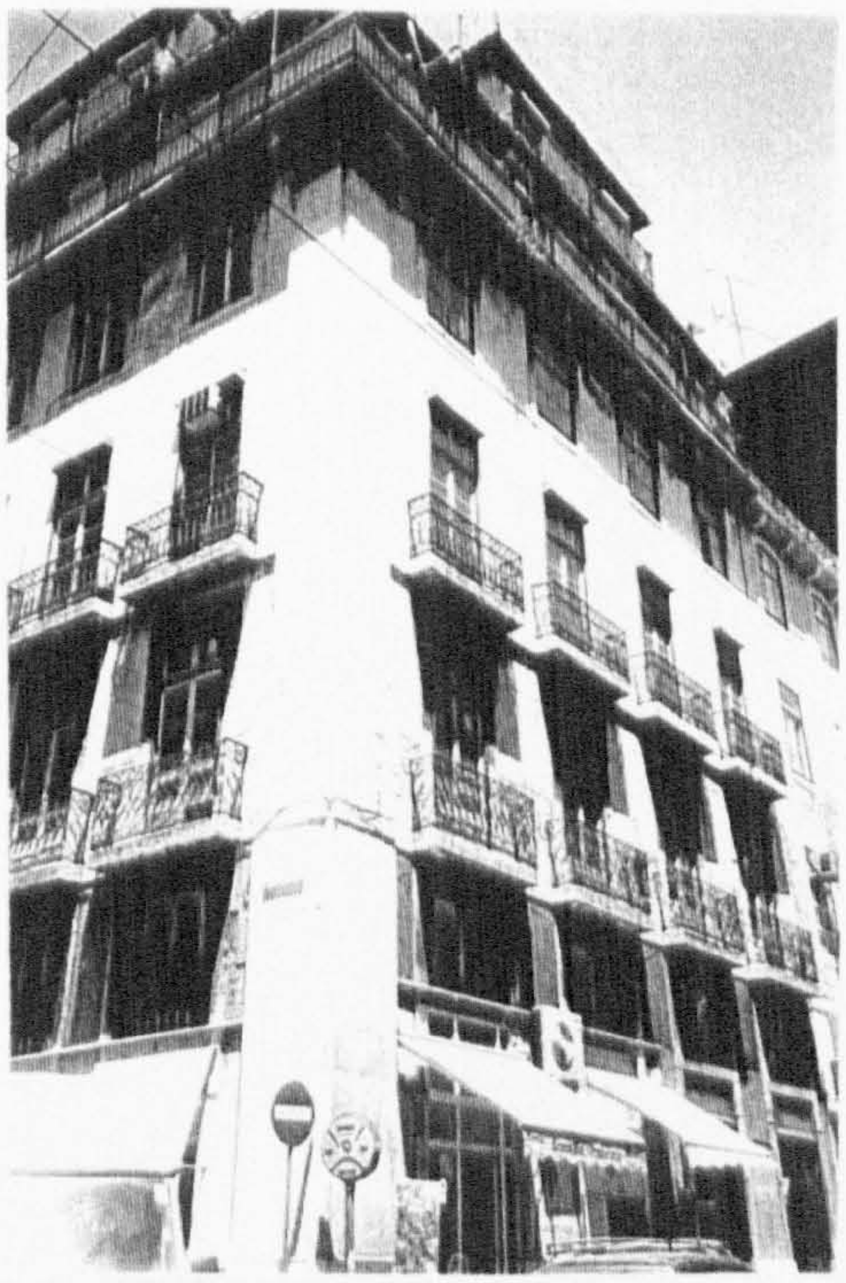
Photograph 2.33-Buildings at Prata Street 1



Photograph 2.34-Buildings at Prata Street 2

Photograph 2.35-Building at Fanqueiros Street.

Photograph 2.36-Building at Correeeeiros Street 1



Photograph 2.37-Building at Correeeeiros Street 2

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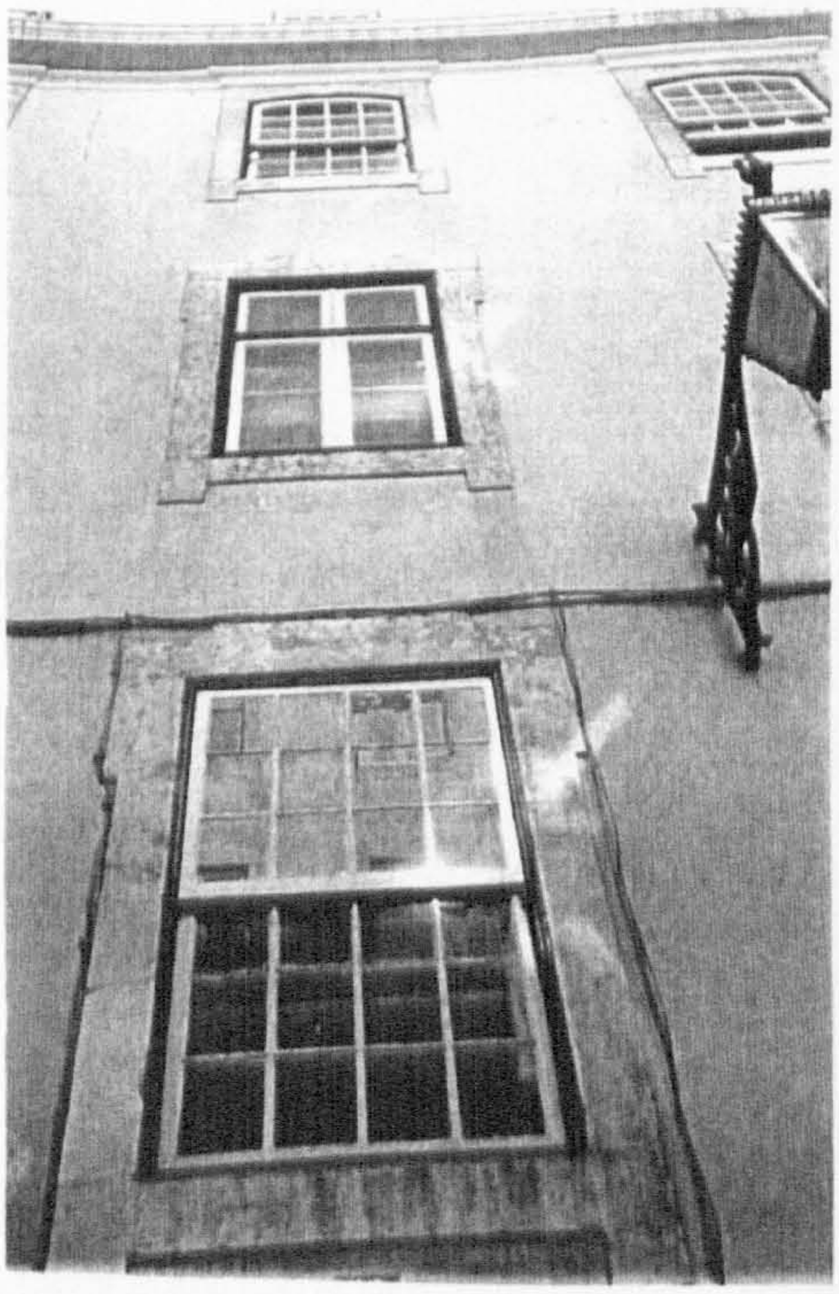
Photograph 2.39-Pilaster used to cover junction between buildings, Prata Street.

Photograph 2.40-Building at Prata Street

Photograph 2.41-Building at Conceição Street.



Photograph 2.42-Old window, S. Nicolau Street.

Photograph 2.43-French window, Rossio Square.

Photograph 2.44-Building at Madalena Street 1

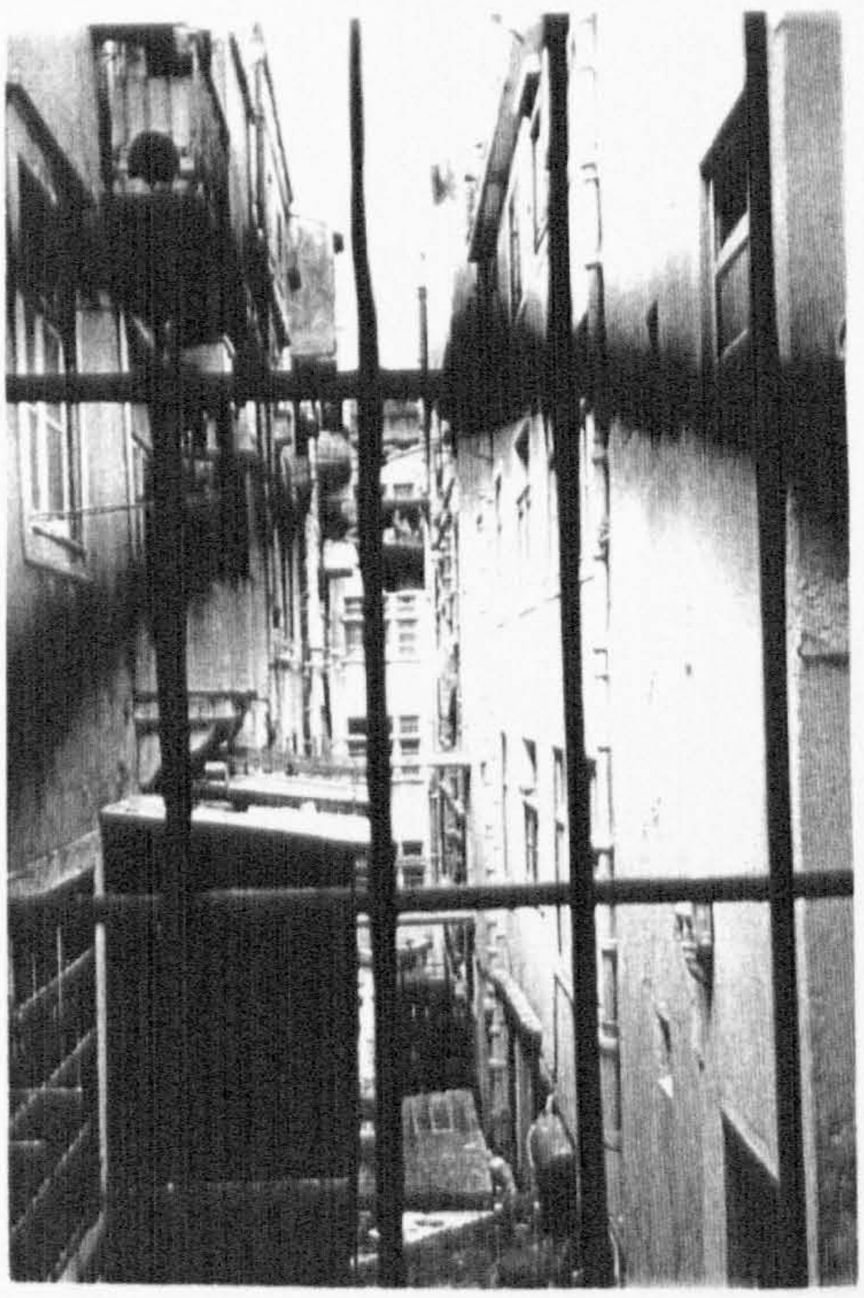
Photograph 2.45-Corner, Douradores and Vitória Streets 1

Photograph 2.46-Building at Madalena Street 2

Photograph 2.47-Corner, Douradores and Vitória Streets 2

Photograph 2.48-S. Vitória Church

Photograph 2.49-S. Julião Chapel.



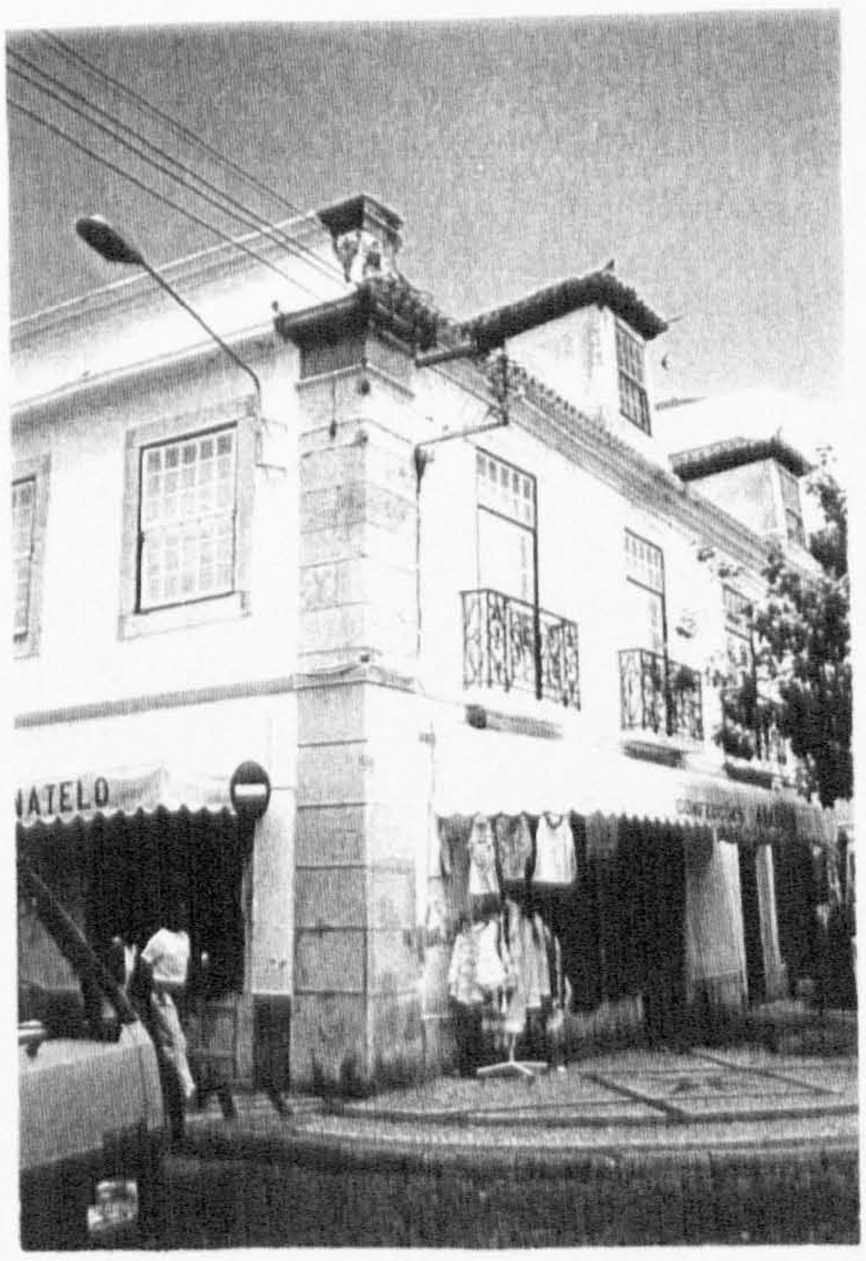
Photograph 2.50- *Alfugere*, block Conceição, S. Julião, Prata and Augusta Streets

Photograph 2.51-A *alfugere*, 39, Fanqueiros Street.

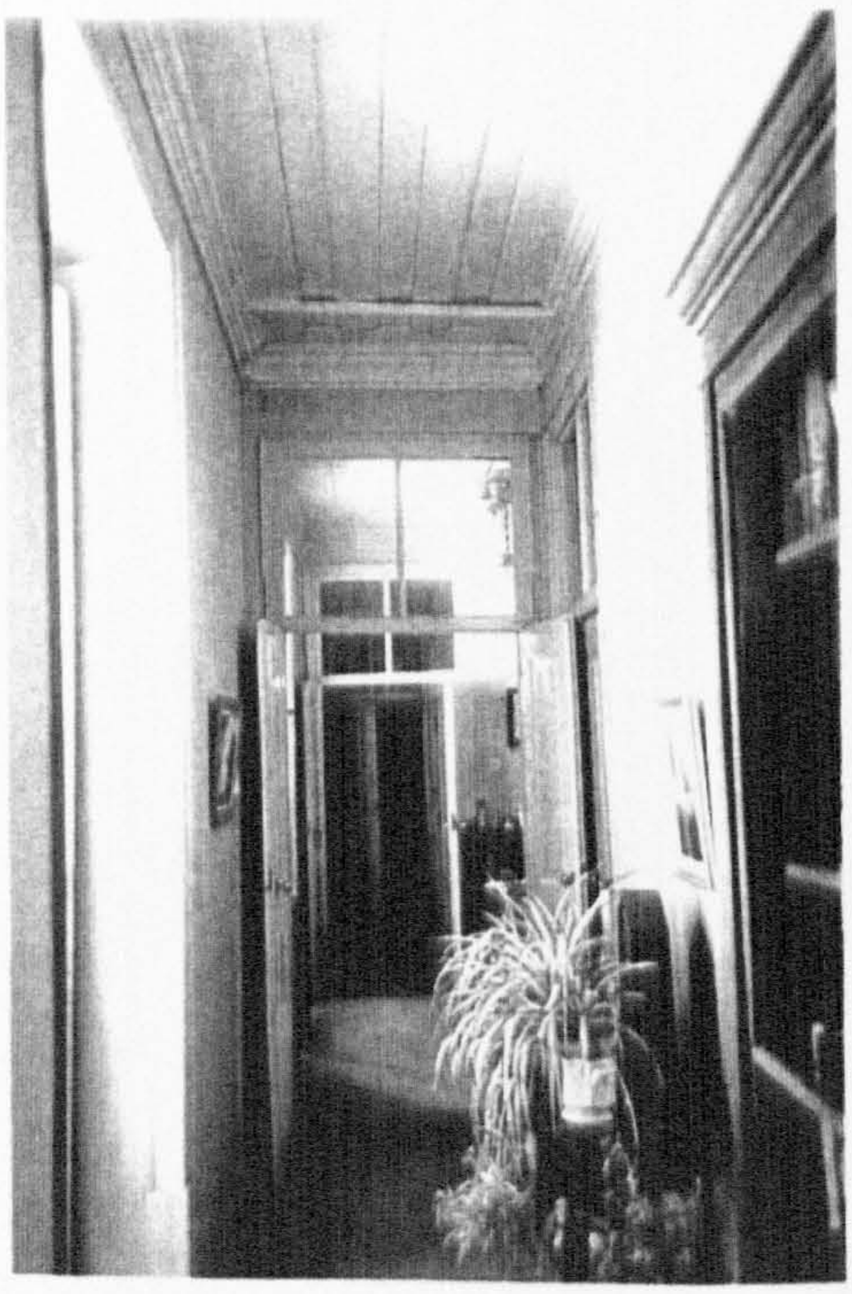
2.2 Photographs of other contemporary Pombaline developments at Vila Real, Porto Covo and Manique do Intendente.

Vila Real

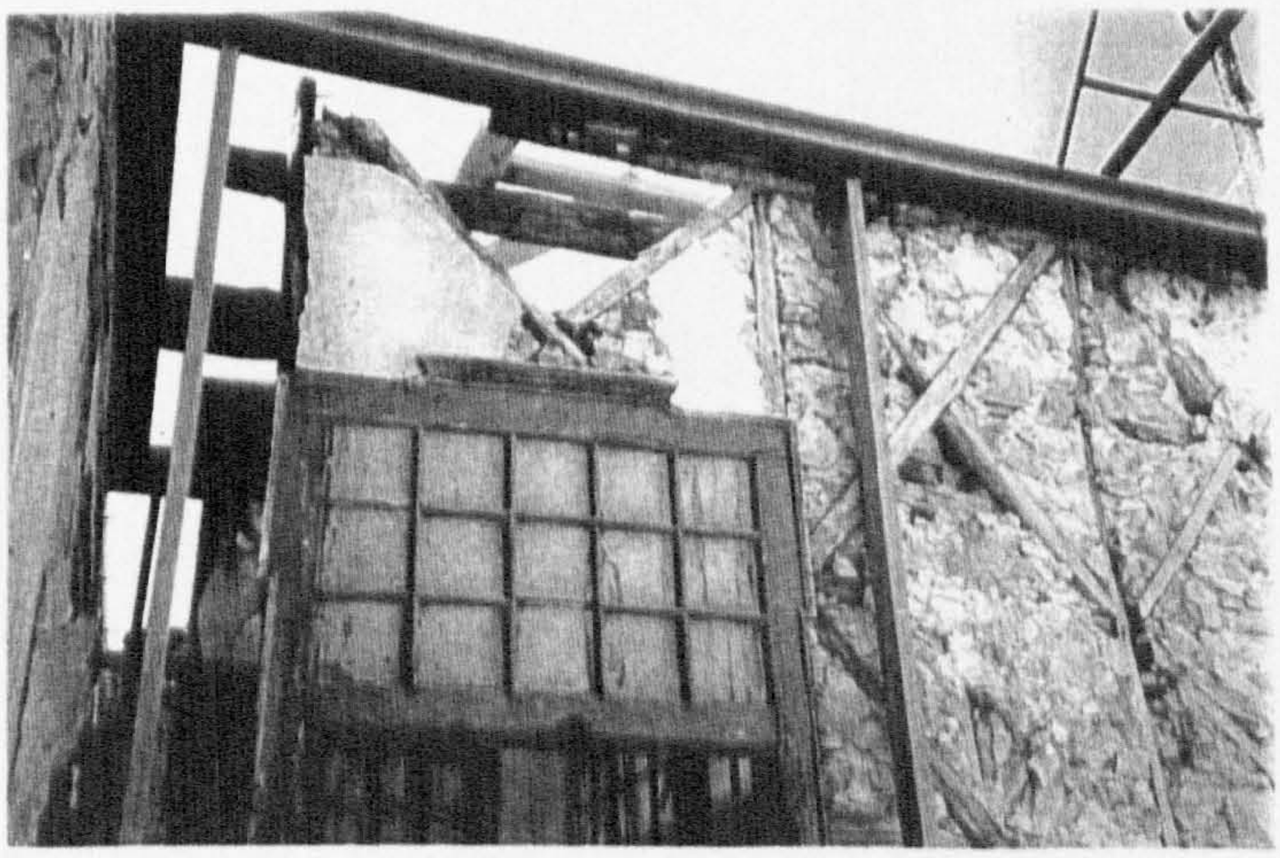
Photograph 2.52 -Sea front houses, society building.



Photograph 2.53 -Sea front house, corner building.

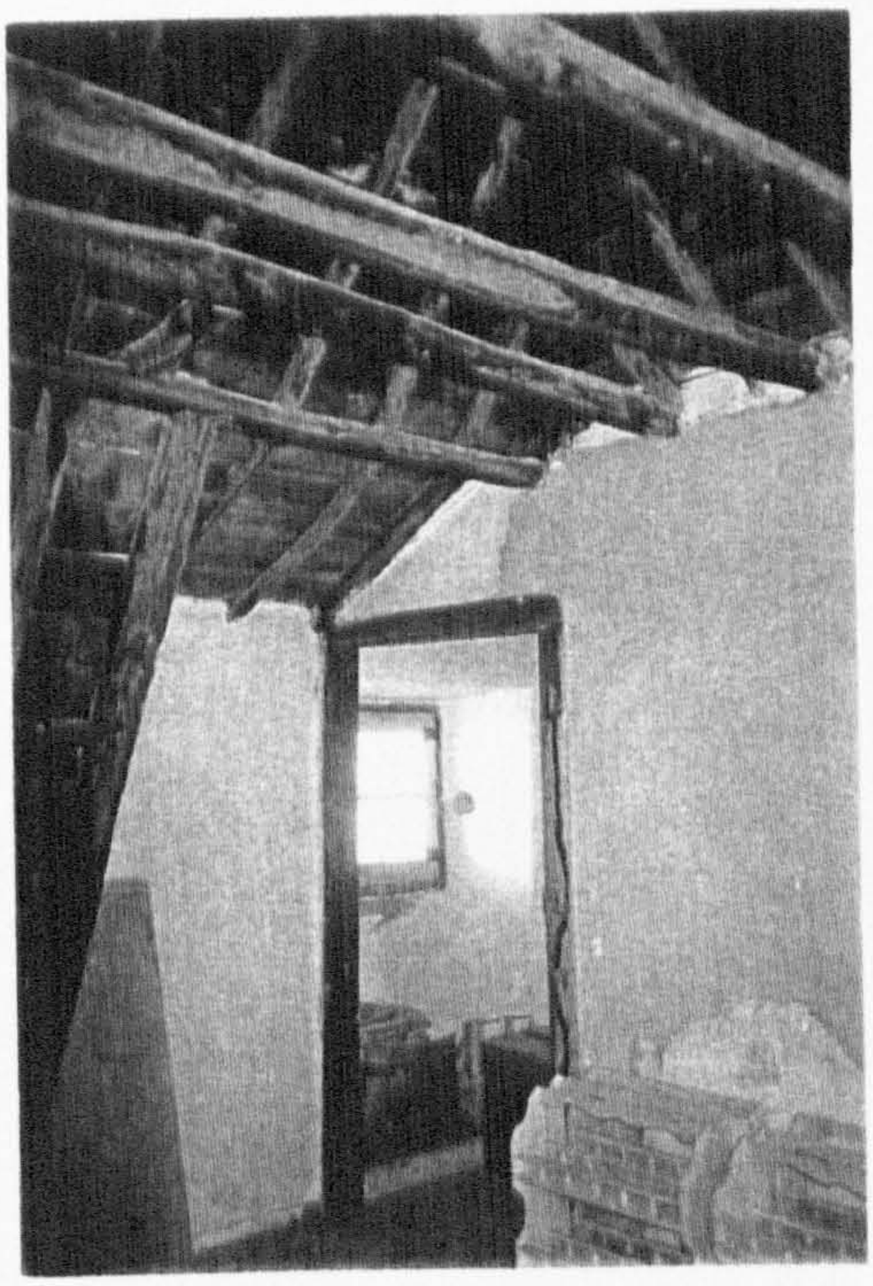


Photograph 2.54 -Sea front house, aspect of the interior.

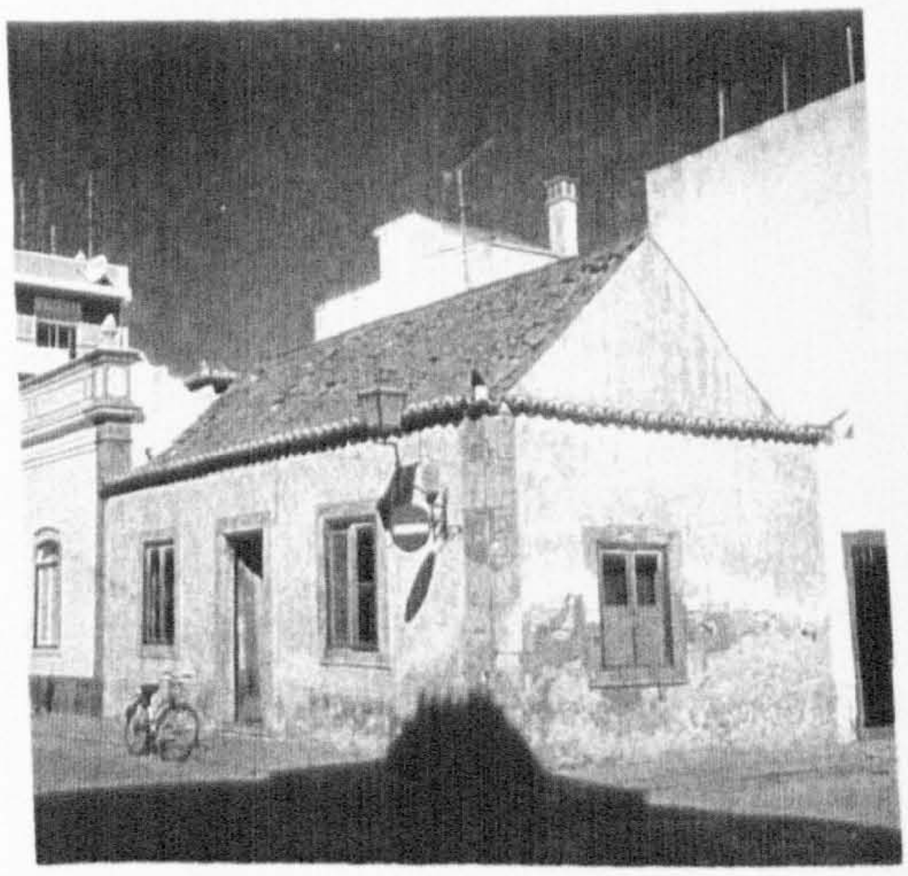


Photograph 2.55 -Sea front house, the cage.

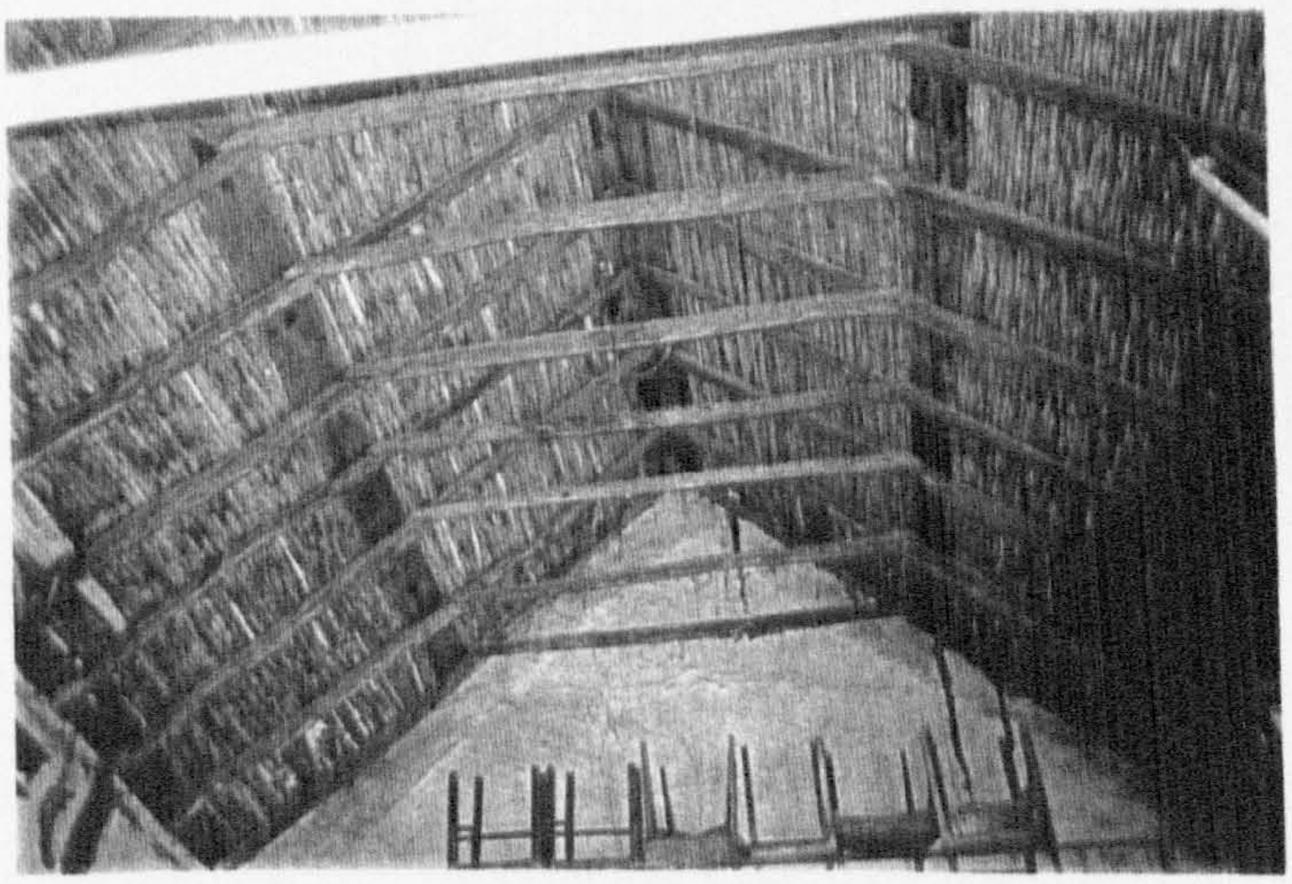
Photograph 2.56 -The central square.



Photograph 2.57-Houses of the square, detail of the roof.



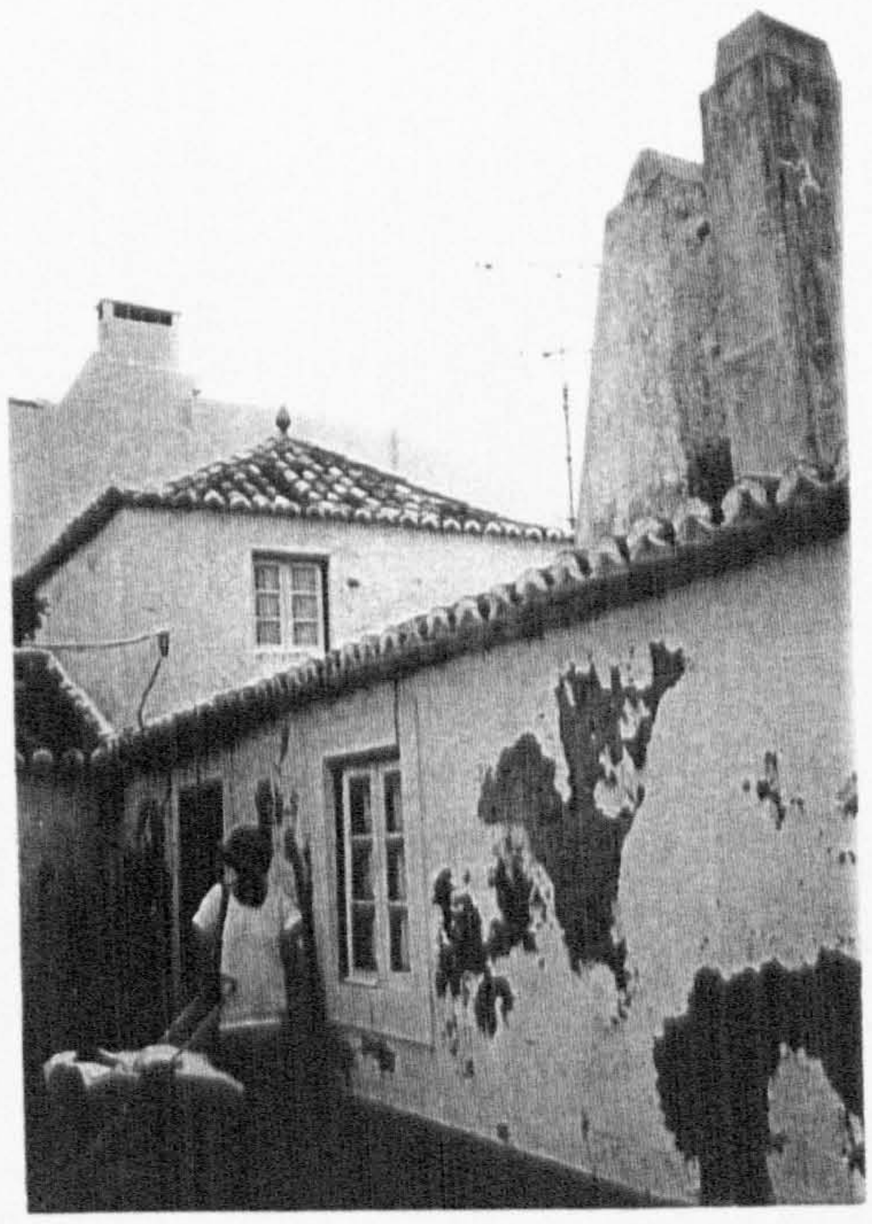
Photograph 2.58 -Ground floor house.



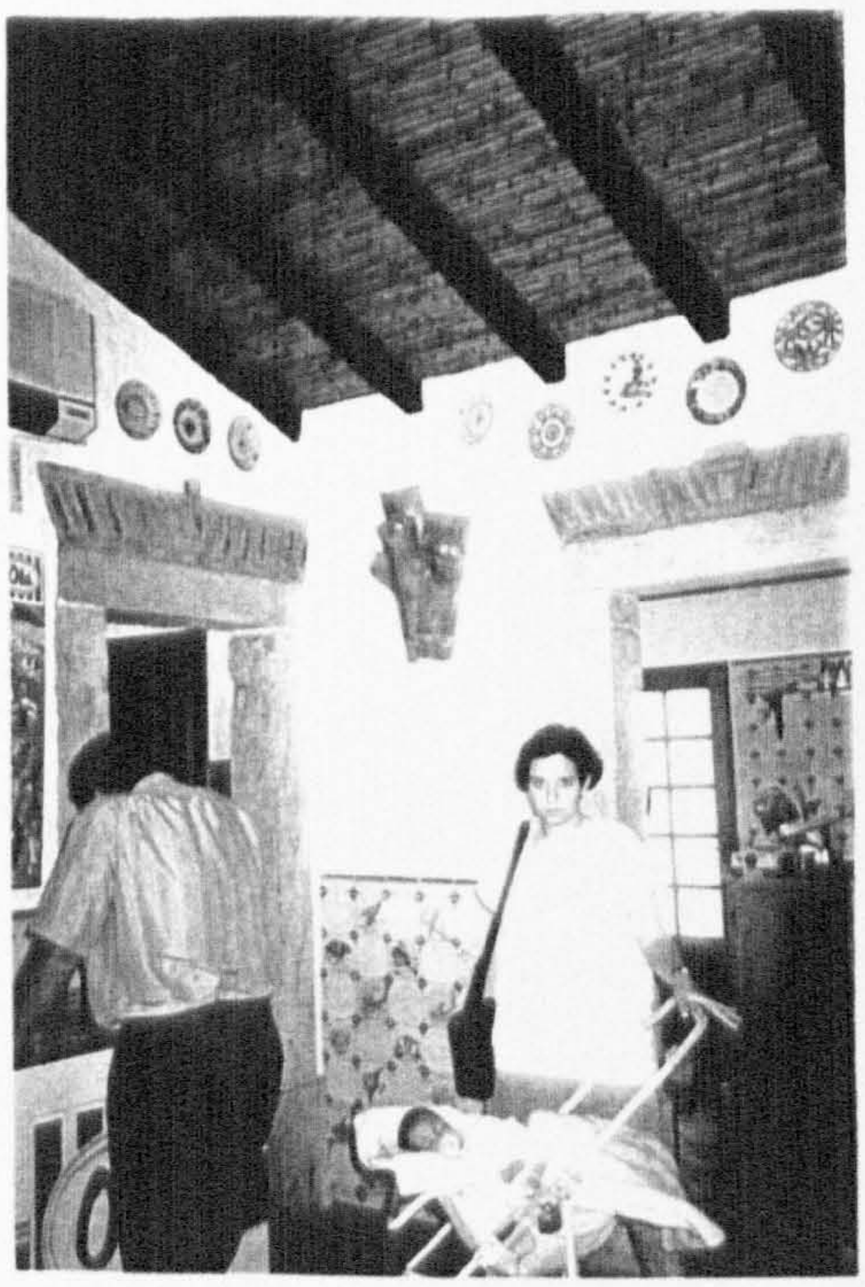
Photograph 2.59-Ground floor house, the structure of the triangular roof.

Porto Côvo

Photograph 2.60 -The square.



Photograph 2.61-Two-level house.



Photograph 2.62 -The ground floor house, sitting room.

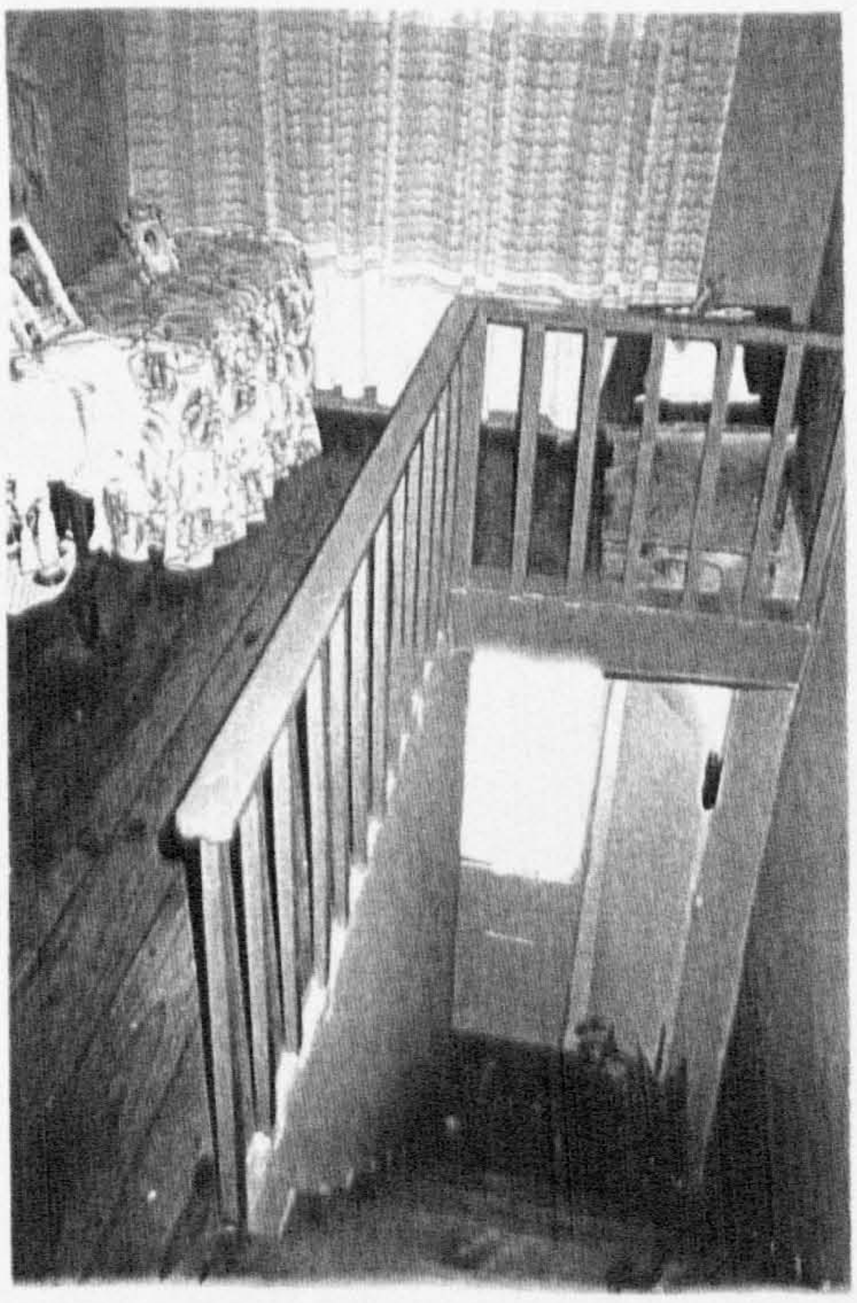
Photograph 2.63-Two-level house, corner of sitting room.

Manique do Intendente

Photograph 2.64-The square, aspect of the houses.

Photograph 2.65-The kitchen.

Photograph 2.66-A house.



Photograph 2.67-The stairs.

Appendix 3 - Description of the construction details of the Pombaline rentable buildings.

Appendix 3 consists of a description of the construction details of the Pombaline rentable buildings. The descriptions are based on detailed records of 230 buildings made by the author, over a ten year period from 1985 to 1995. During this period 19 buildings have been completely or partially demolished except for the external walls, and six further buildings have been substantially altered. Because most of the construction details are only visible during alterations or destruction of buildings, for the majority of buildings it is difficult to specify the exact way in which they were built although the method must be clearly similar or identical to the twenty-three for which the author was able to make very detailed studies.

The buildings which were partially or completely demolished during the period of study are listed below.

	Location	Total destruction of interior	Partial destruction of interior
A.	9-13, Correeiros Street,	x	
B.	15-23, Correeiros Street,	x	
C.	25-35, Correeiros Street,	x	
D.	76-84, Augusta Street,	x	
E.	86-94, Augusta Street,	x	
F.	50-54, Ouro Street,	x	
G.	56-60, Ouro Street,	x	
H.	185-195, Douradores Street,	x	
I.	85-91, Prata Street,	x	
J.	2-8, Santa Justa Street,		x
K.	51, São Nicolau Street,		x
L.	75, Conceição Street,		x
M.	110, São Julião Street,		x
N.	185, Prata Street,		x
O.	107-111, Correeiros Street		x
P.	69, Ouro Street	x	
Q	179, Correeiros Street		x
R.	141, Augusta Street	x	
S.	84, Sapateiros Street	x	

3.1 The foundations.

Examination of these buildings while they were being completely or partly demolished revealed an ingenious foundation system. This had been developed using wooden piles that allowed the buildings to "float" on the underlying alluvium, (Fig.3.1).

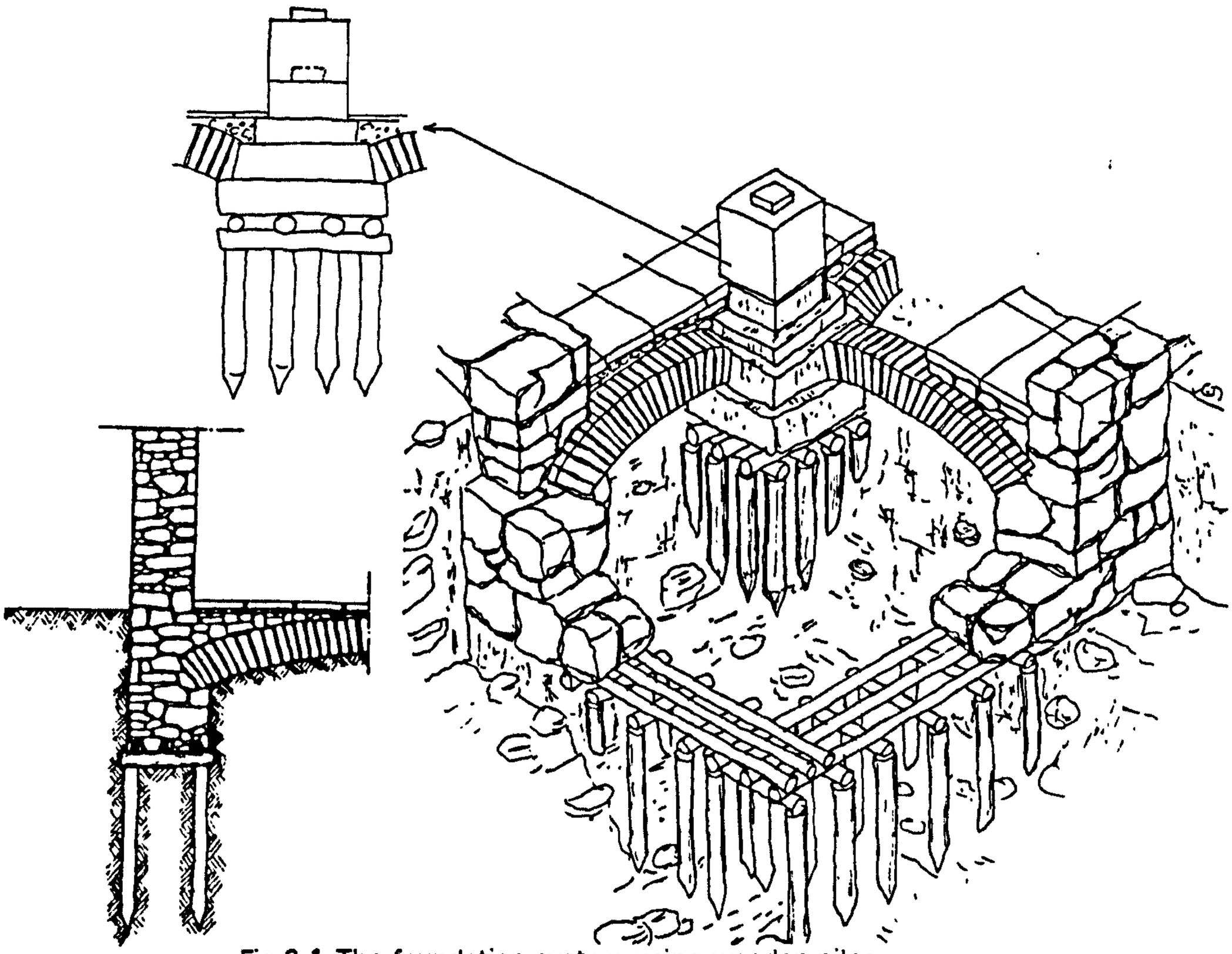


Fig.3.1-The foundation system using wooden piles,
also detail of the pillars and the arches

The author observed (buildings A, B, C and G) that the piles were similar and repetitive, on average 15 cms in diameter and under 1.5 m in length, forming two parallel rows in the directions of the main walls, which were linked at the top by horizontal cross-members attached by thick iron nails. Three rows of poles, three to five metres in length, were nailed longitudinally on top of the cross-members. The system of using piles consisting of green pine logs below the watertable, without light or air made it impossible for any kind of infestation to develop. Thus, the wood was preserved indefinitely.

Beneath the internal walls, the use of piles was limited to the points of intersection. At these points, a stone foundation pier was built. A stone foundation wall, about 0.80 m thick, was built on top of the assembly of piles and horizontal poles for the external walls.

The continuity of the construction was established (building F) by connecting the foundation walls and piers with brick arches, surmounted by stone walls which were the base for the walls or piers of the building, (Fig.3.1).

The author also observed a few cases (building G) in which piles and horizontal poles, as described above, were used at foundation level throughout the building, making a complete platform on which the building was set, (see Fig.3.2) The adoption of this solution seems not to be related to the soil conditions, as the two different systems have been found in adjacent buildings on identical soil conditions. Possibly the second solution was adopted later in order to avoid the complex arch construction.

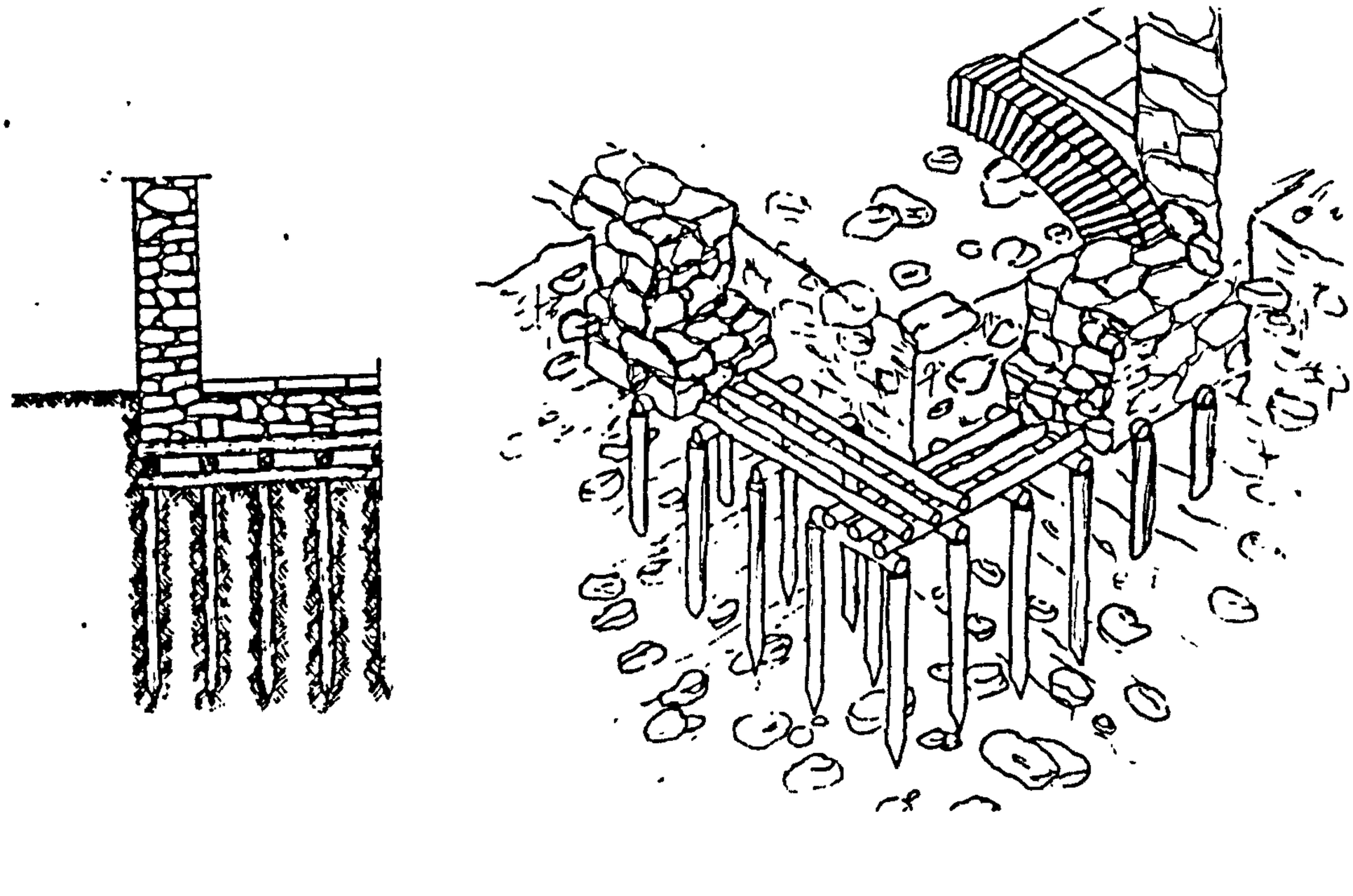


Fig.3.2-"Platform" foundation system.

3.2 The ground floor.

The construction between the ground and first floors consisted of (buildings D, F and I) solid walls and piers linked by a system of arches (Fig.3.4). In more elaborate cases, especially on secondary streets where stores and stables were located, (buildings A, B and C) thick groined vaults spanned between the arches, (Fig.3.3). This solution enabled the building to withstand the movement of the land in the event of tremors or any imbalance caused by neighbouring buildings, and protected all the construction from the spread of any fire that might start at ground floor level, which was occupied by storehouses or coach houses.

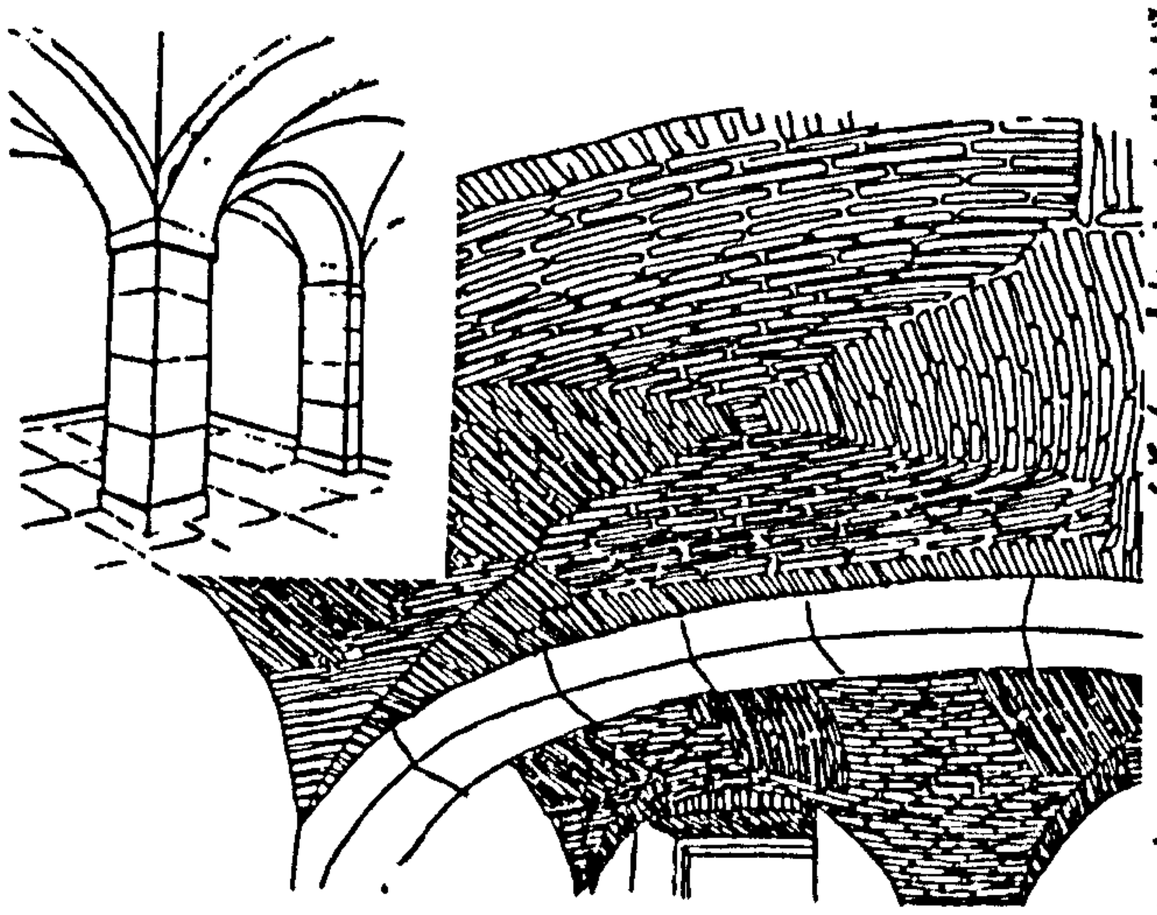


Fig.3.3-In more elaborate cases there were thick groined vaults over the arches

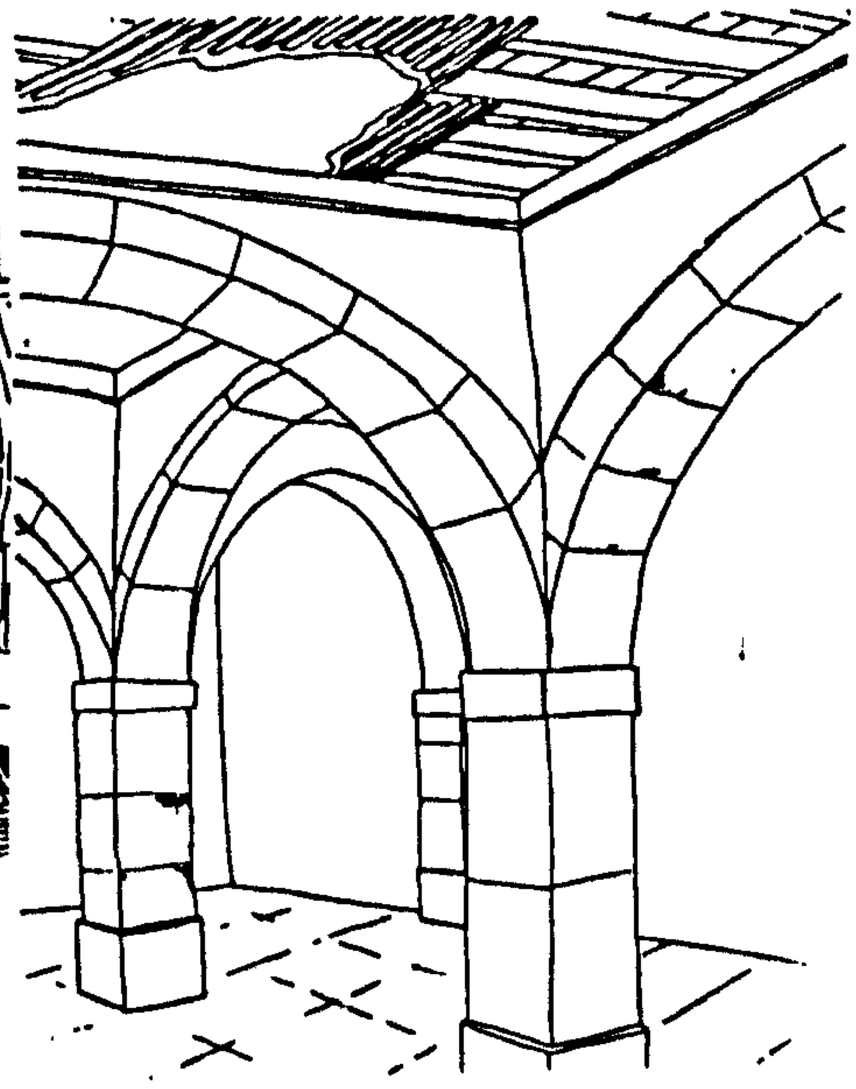


Fig.3.4-The shops were made up of solid walls and piers linked by arches

The walls were always built with large stones which had been crudely cut and the spaces between them were filled with smaller stones and a lime/clay mortar, which helped to bind the large stones together and make the surface of the walls smoother. For fire safety reasons at ground floor level the structure of the cage was rarely incorporated into the walls.

At the points where partition walls crossed on the upper floors, thick piers of notched, interlocking stones were built at ground floor level.

Spanning over ground floor rooms of varying proportions was achieved by using quadripartite vaults. This type of vault is distinguished by the fact that it is made up of four curved surfaces which intersect at the diagonals of the space covered, (Fig.3.5) and for ease of construction, bricks were used.

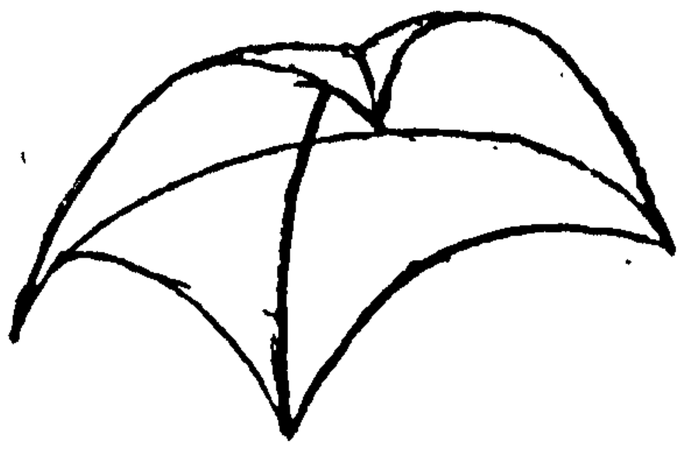
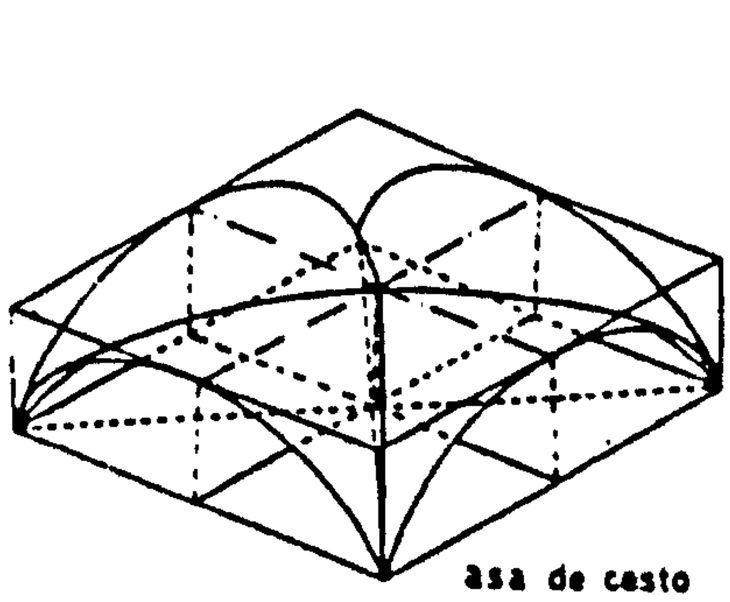


Fig.3.5-The quadripartite vaults



Toral brick arches were built (buildings A, B and H) on the perimeters of the vaults; they were needed for structural reasons, and there was a strong tradition of building them which extended back long before the earthquake, (Fig.3.6).

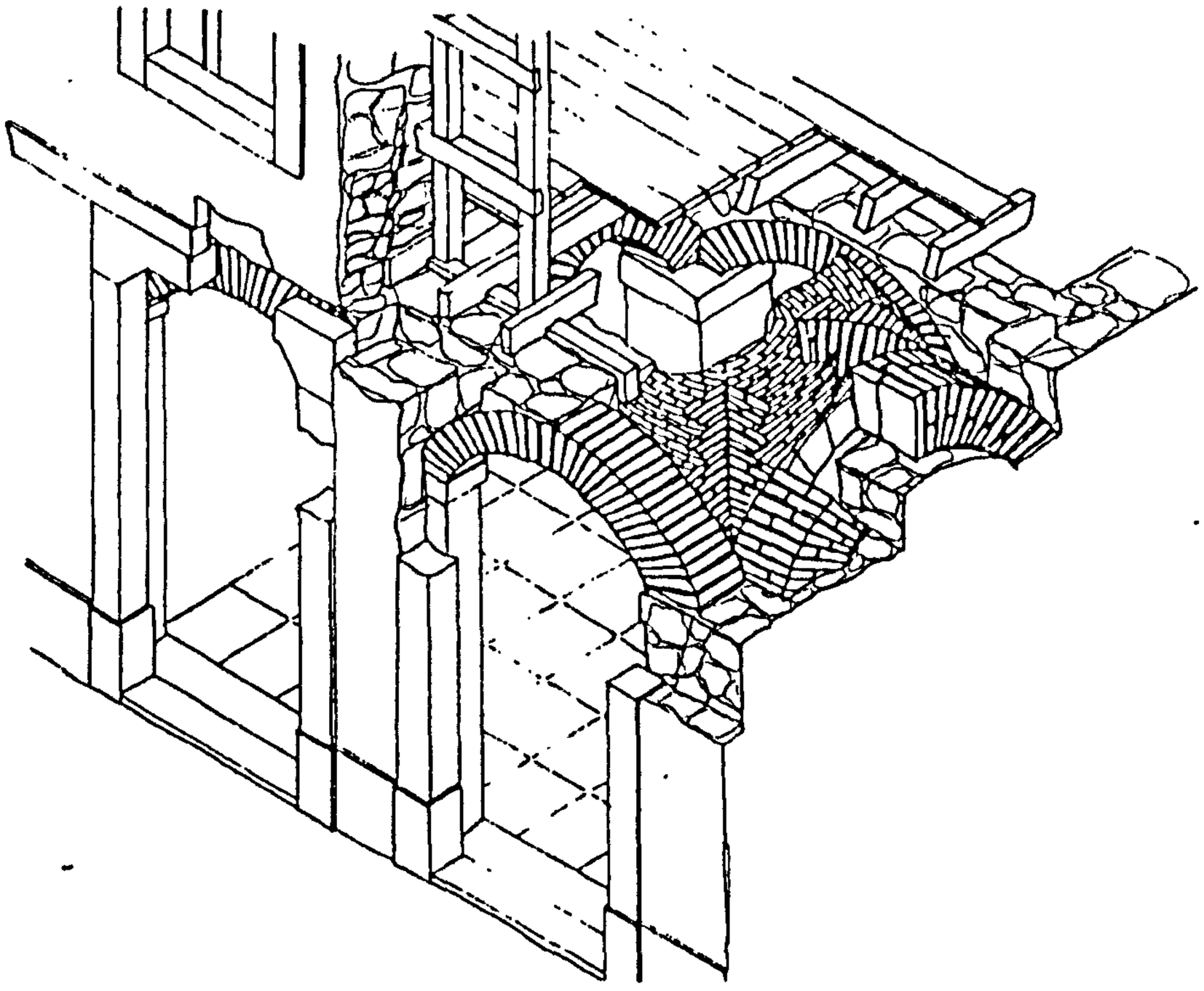


Fig.3.6-Construction detail of the vaults

Next to the façades, these arches fulfilled the additional function (buildings B and C) of supporting the inner half of the external wall, the outer half being supported by lintels. The wooden structure of the upper floor, rested over the vaults, (Fig.3.7).

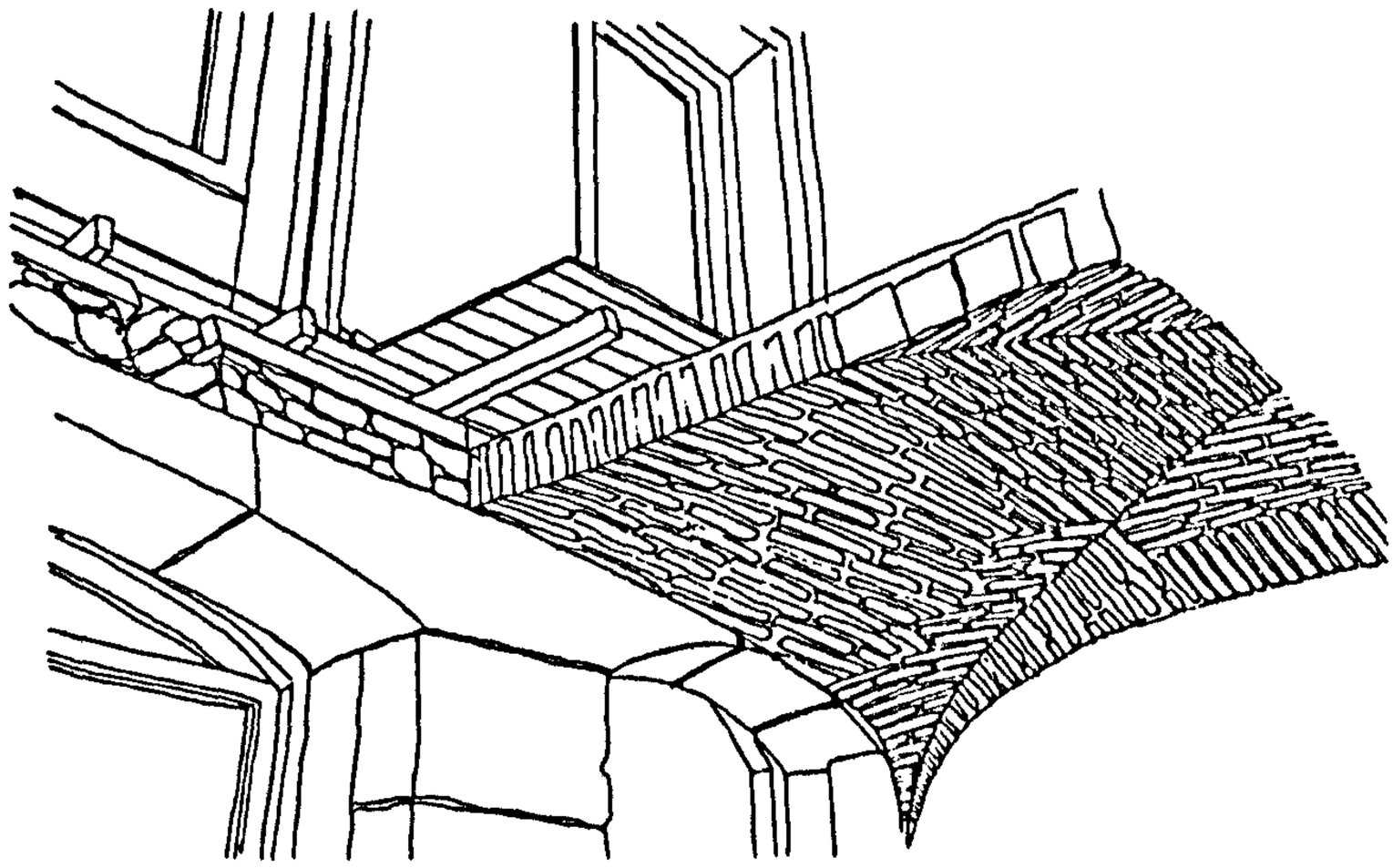


Fig.3.7-The lintel near a front door and wood structure of the upper floor over the vault

In the main streets, where there are no vaults over the ground floor rooms, there are two variations of the form of construction: arches in parallel lines (building E) (Fig.3.8); and arches perpendicular to one another, forming a grid in plan (building I) (Fig.3.4). On the internal faces of the external walls, segmental brick arches (building I) (Fig.3.9) or flat stone arches (building E) (Fig.3.10) are found.

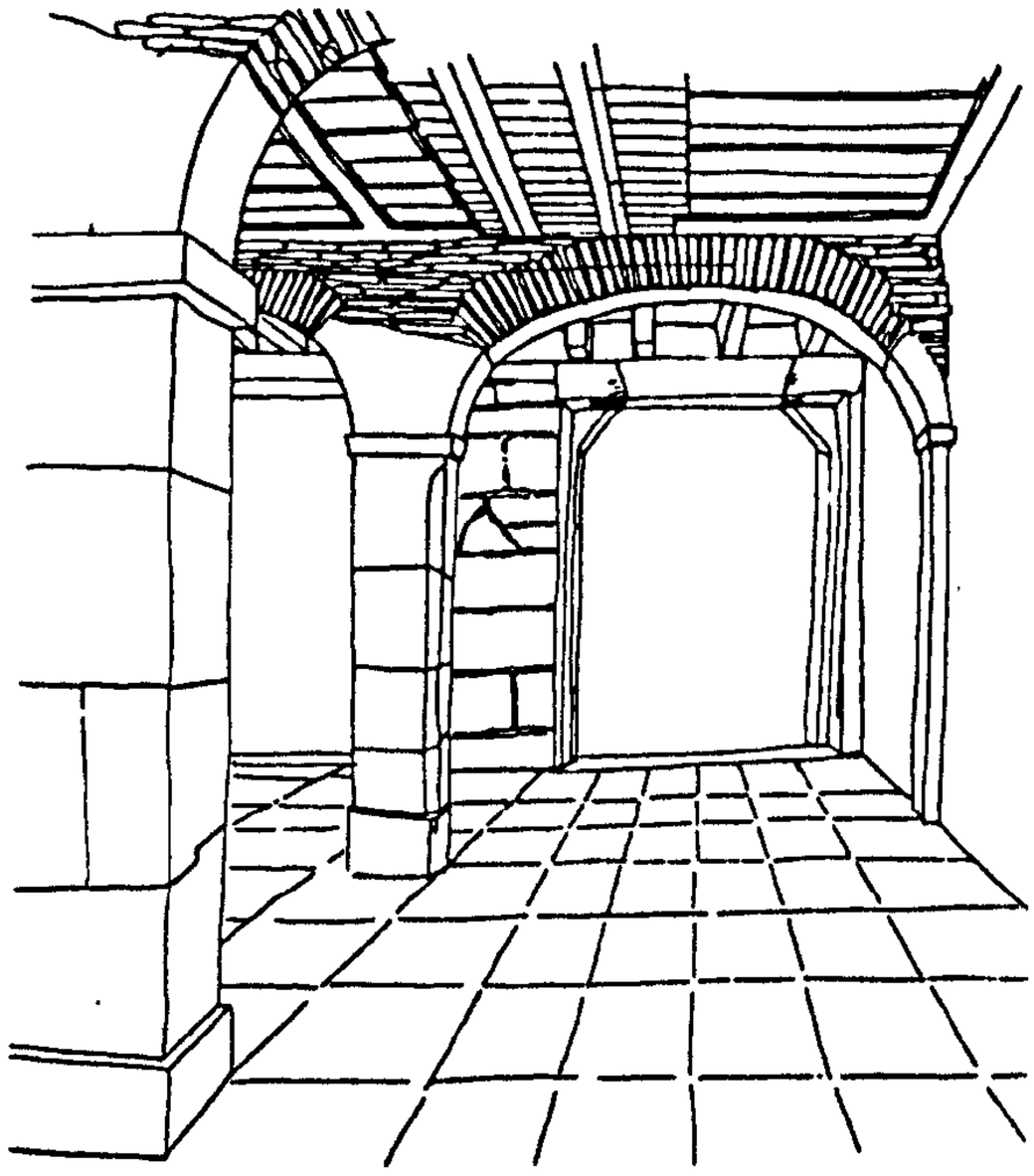


Fig.3.8-Parallel line of arches

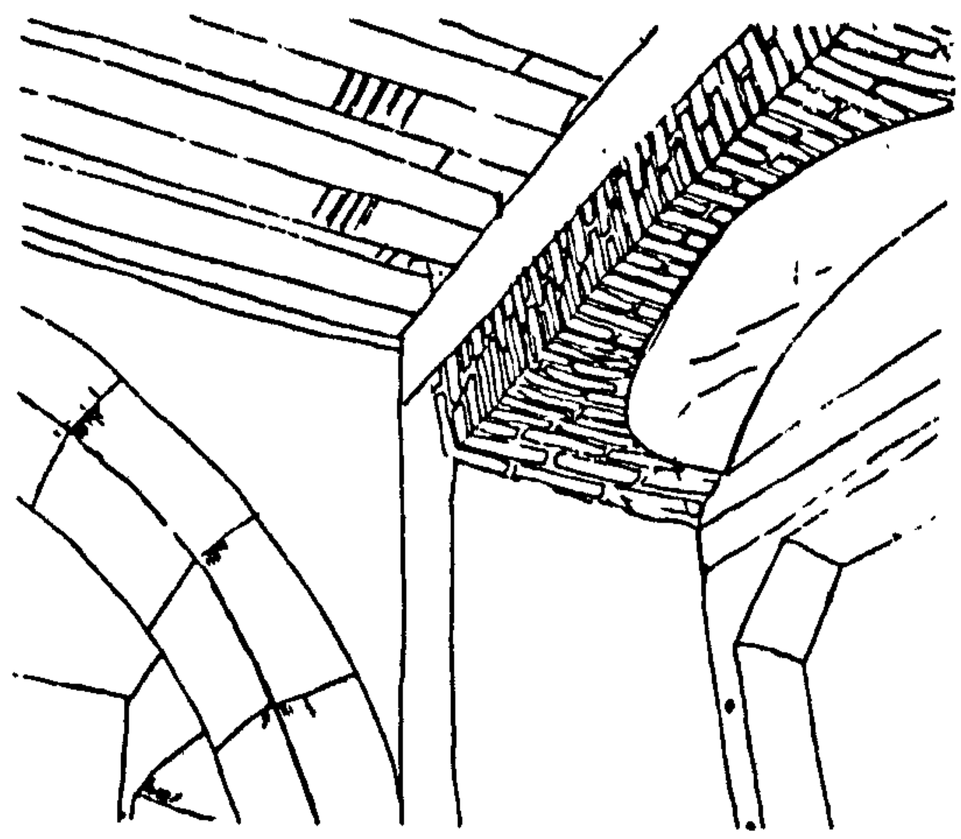


Fig.3.9-Segmental brick arch on internal face of external wall.

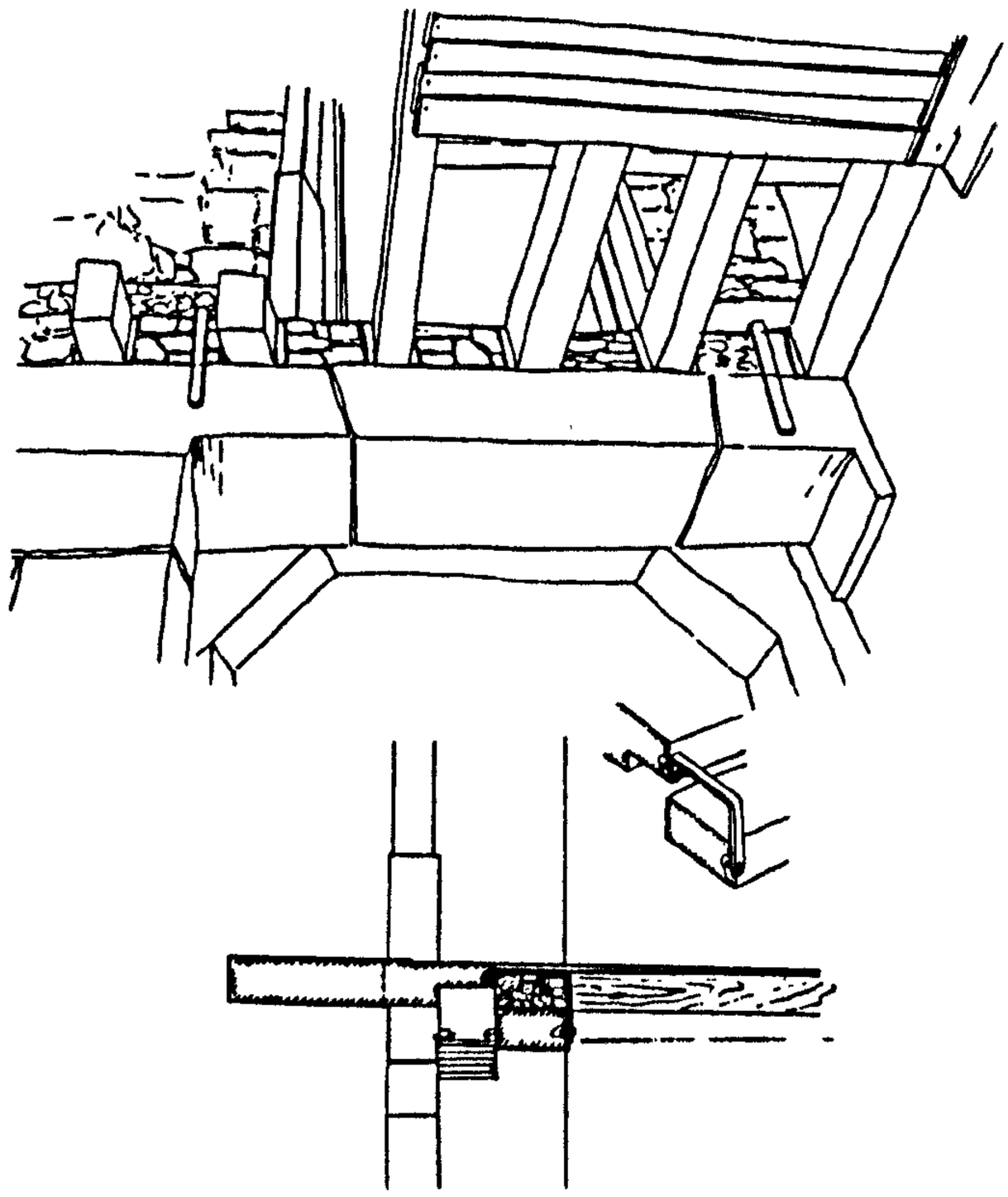


Fig.3.10-Flat stone arch with detail of the balcony

3.3 The *gaiola* (cage).

The *gaiola* or wooden cage structure may have been based on traditional wooden structures, such as those of some houses on the Castle Hill in Lisbon (Fig.3.11).

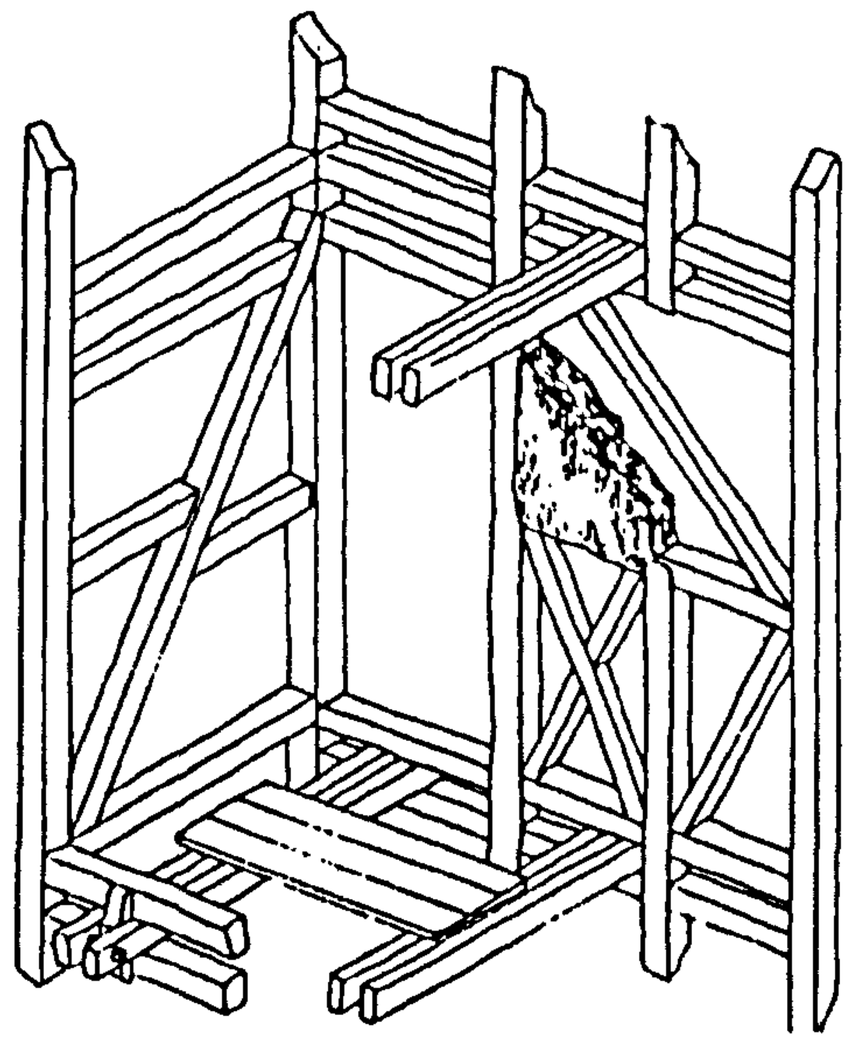


Fig.3.11-Timber frame used in the Castle Hill district of Lisbon prior to the earthquake*.

The cage in the Pombaline buildings was quite ingenious in its simplicity of construction and besides offering improved safety for both people and property, it allowed the buildings to be higher than the previously stipulated two floors on land that was very unstable, (see Fig.3.13 on next page).

The structure of the *gaiola* is basically made up of a matrix of panels with horizontal, vertical and diagonal members which form a series of Saint Andrew´s crosses, (Fig.3.12 and 3.14). This design of the structure is probably derived from empirical knowledge of the fact that it is difficult to deform a triangle. Thus, the squares or rectangles, defined by the crossing of the vertical posts and the horizontal rails, are transformed into triangles through the use of diagonal struts.

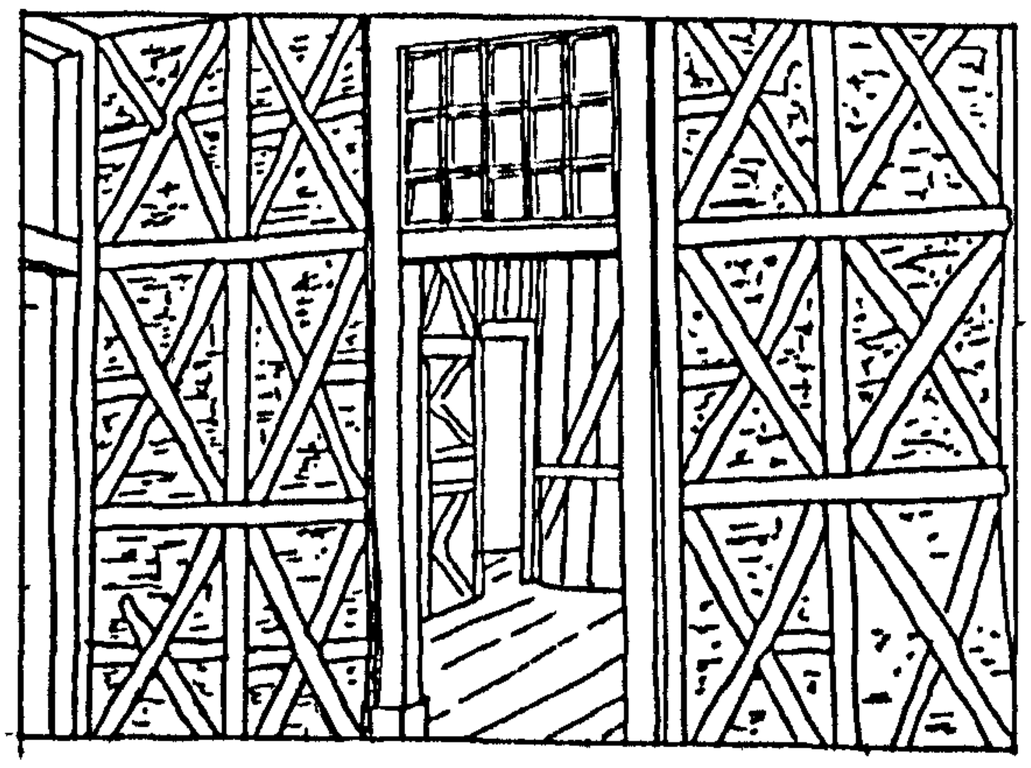


Fig.3.12- View of the cage panels from the interior of a flat.

Fig.3.13-Isometric of a *gaiola* (cage), 85, Ouro Street

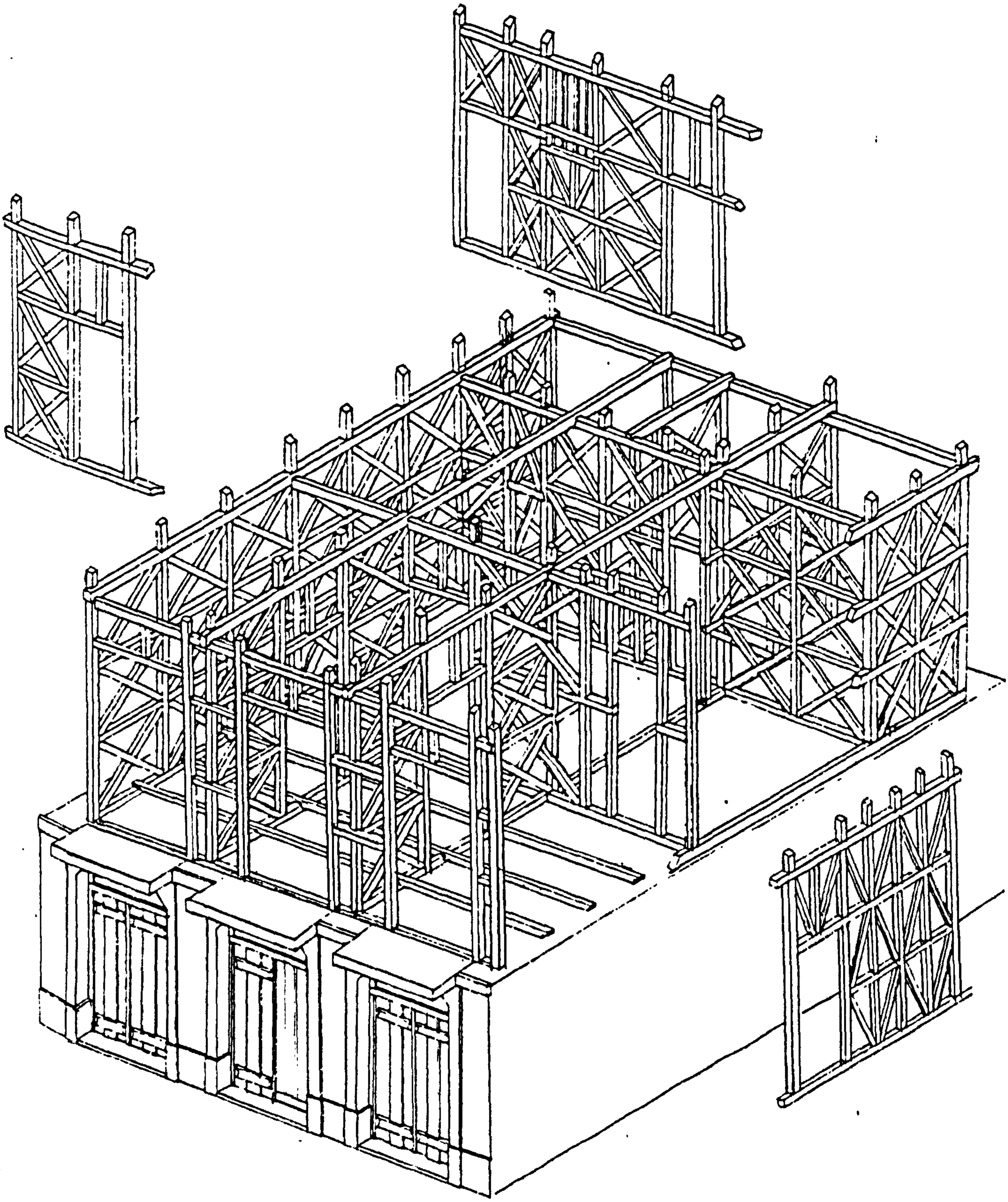


Fig.3.14-Isometric of a *gaiola* (cage) corresponding to the first floor

85, Ouro Street

As the structure was made up of numerous short and repetitive struts, with reduced sections, it was possible to overcome the problem of the scarcity of wood in the Lisbon area, and at the same time, allow for better modulation in plan and in elevation, with the options of being able to leave open spaces wherever they were required.

The module size allowed for the lower floors, which had higher ceilings, to be three or four modules high, while the upper floors would be two and half, and the attic floor only two, (see Fig.3.15 and 3.16). The reduction in the number of modules was occasionally accompanied by the appearance of vertical and horizontal reinforcement, (building F)(Fig.3.17).

The structure of the stairwell and staircase were generally reinforced by horizontal elements so that there would be multiple support points for the structure of the stair landings, (Fig.3.18 and 3.19).

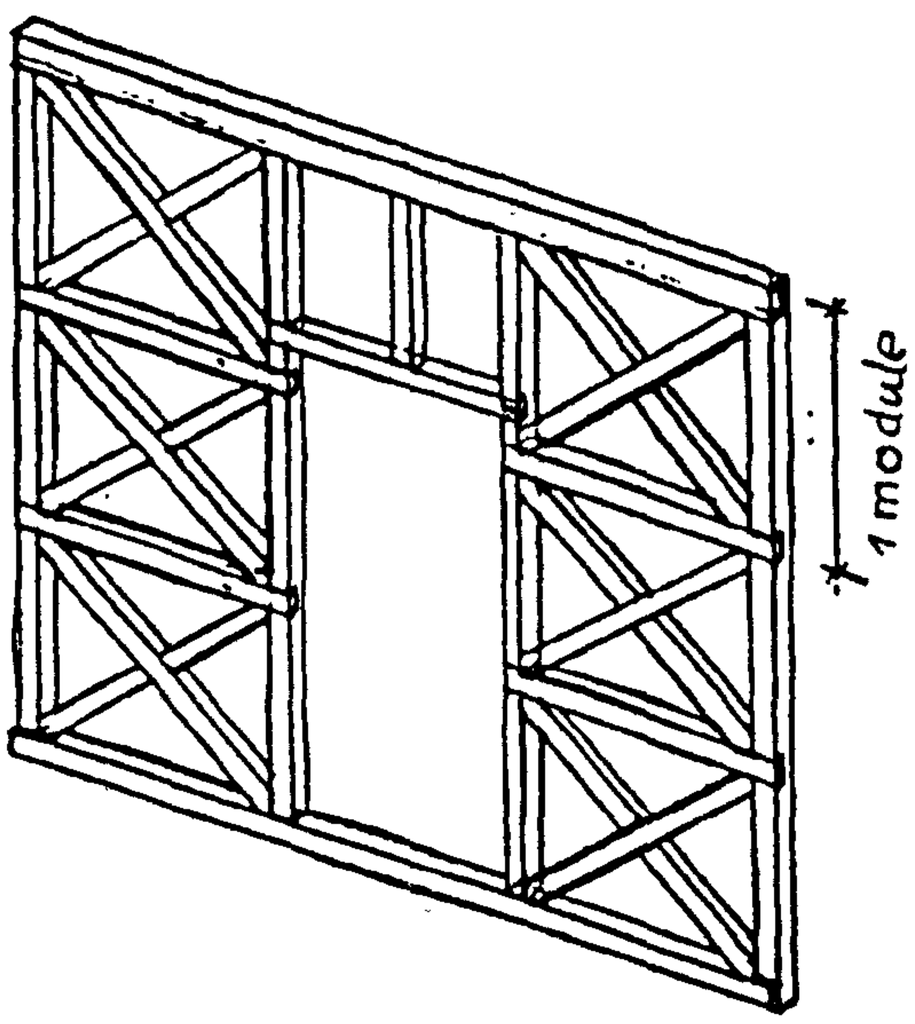


Fig.3.15-Part of panel of structure used on lower floors with three modules (building G)

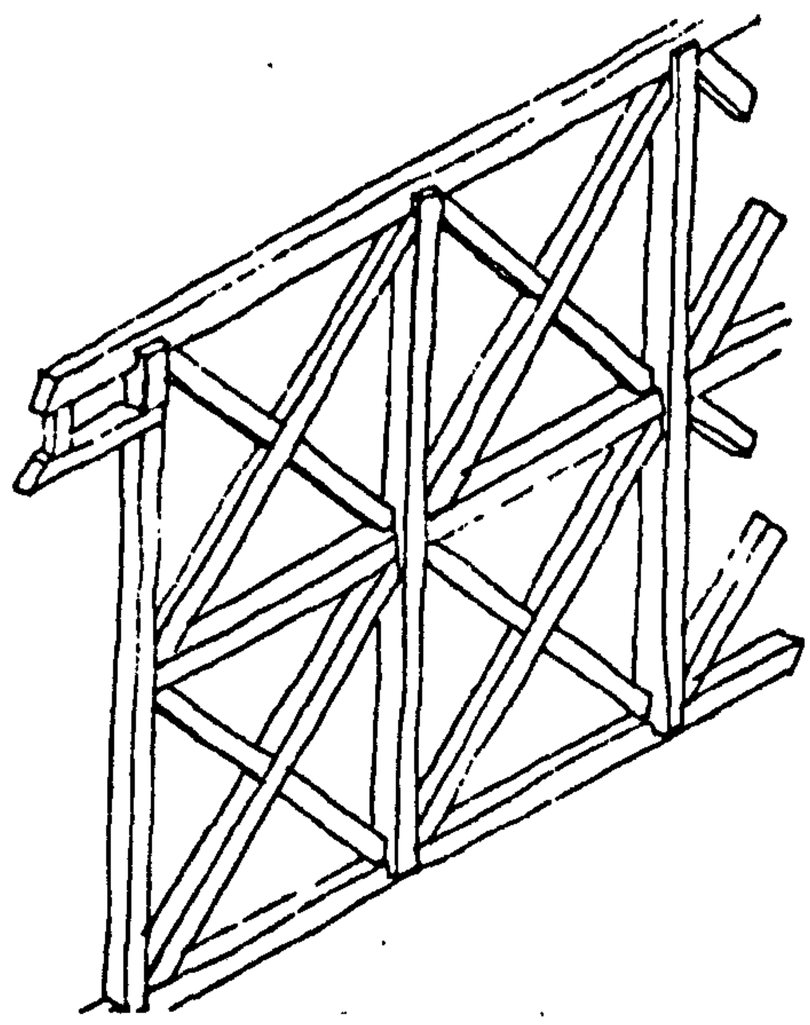


Fig.3.16-Structure used on upper floors with two modules (building G)

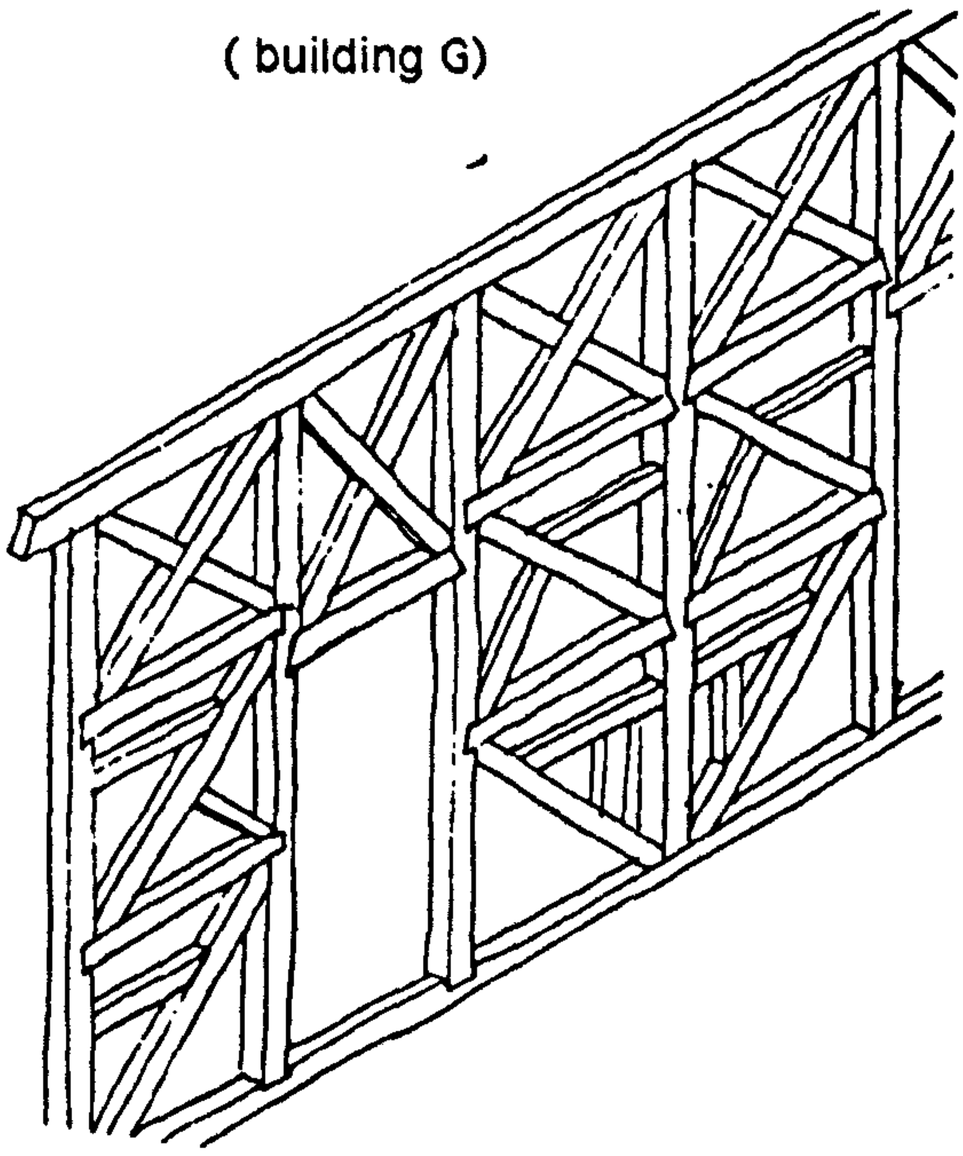


Fig.3.17-Structure with vertical and horizontal reinforcements

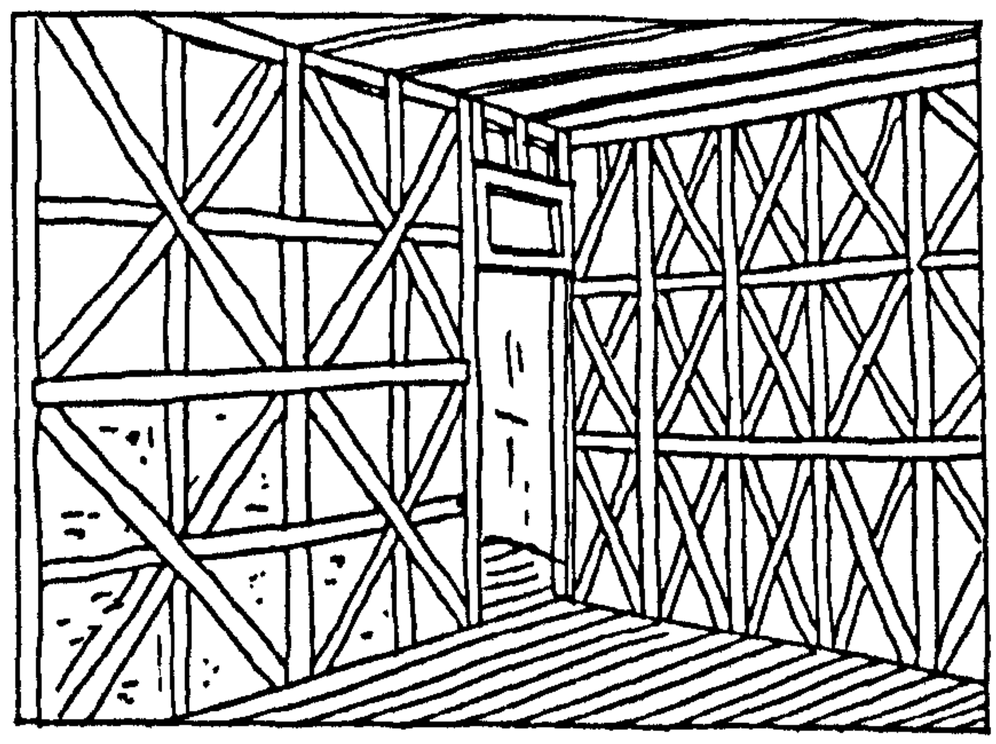


Fig.3.18-The left panel has been reinforced with horizontal elements because behind is supporting a stair.

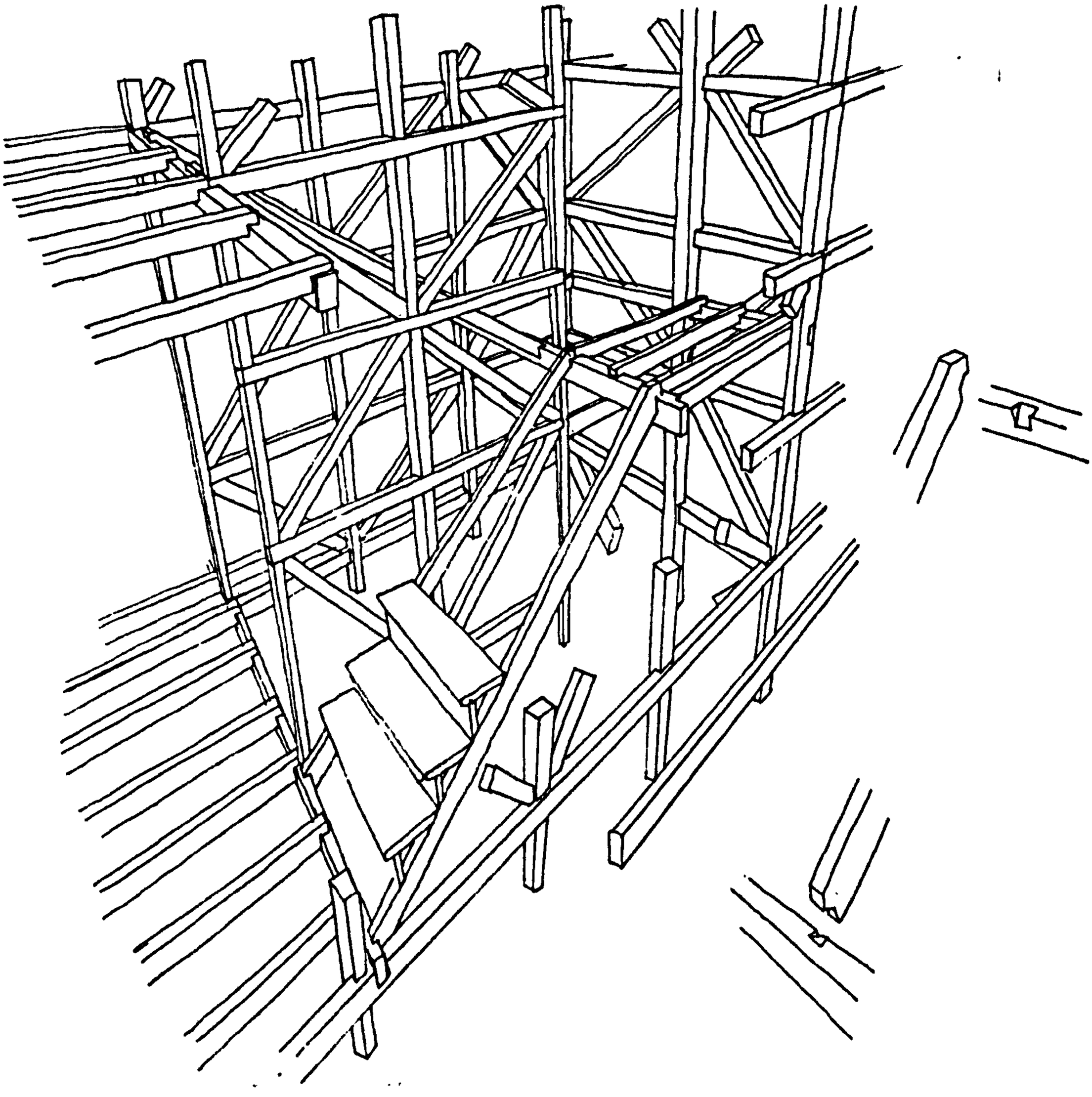
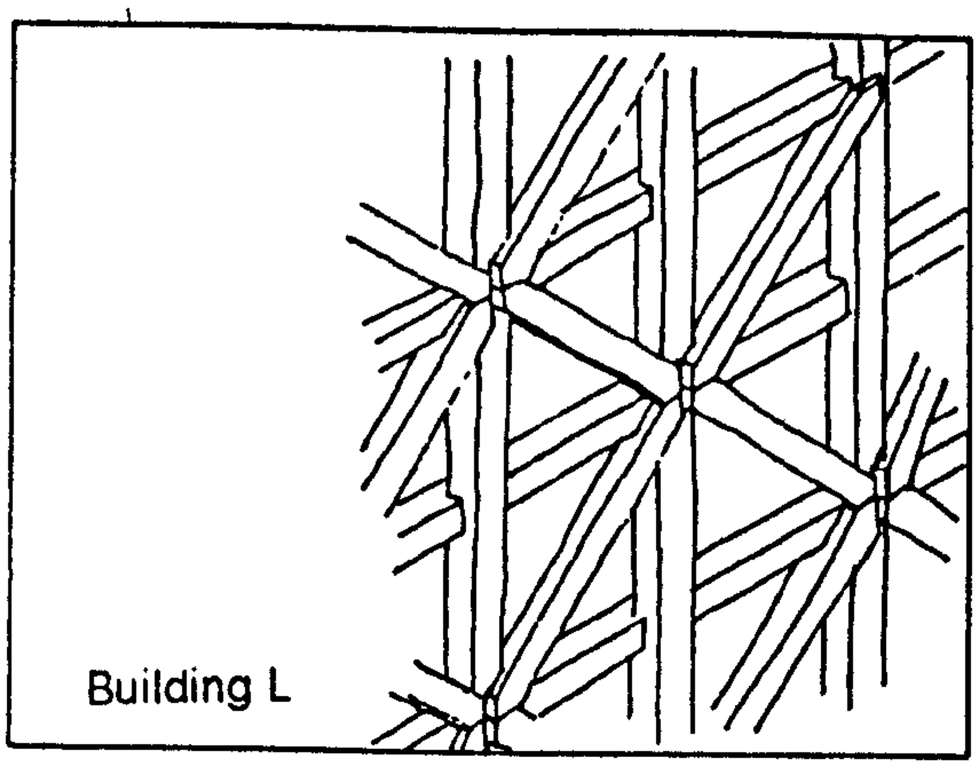
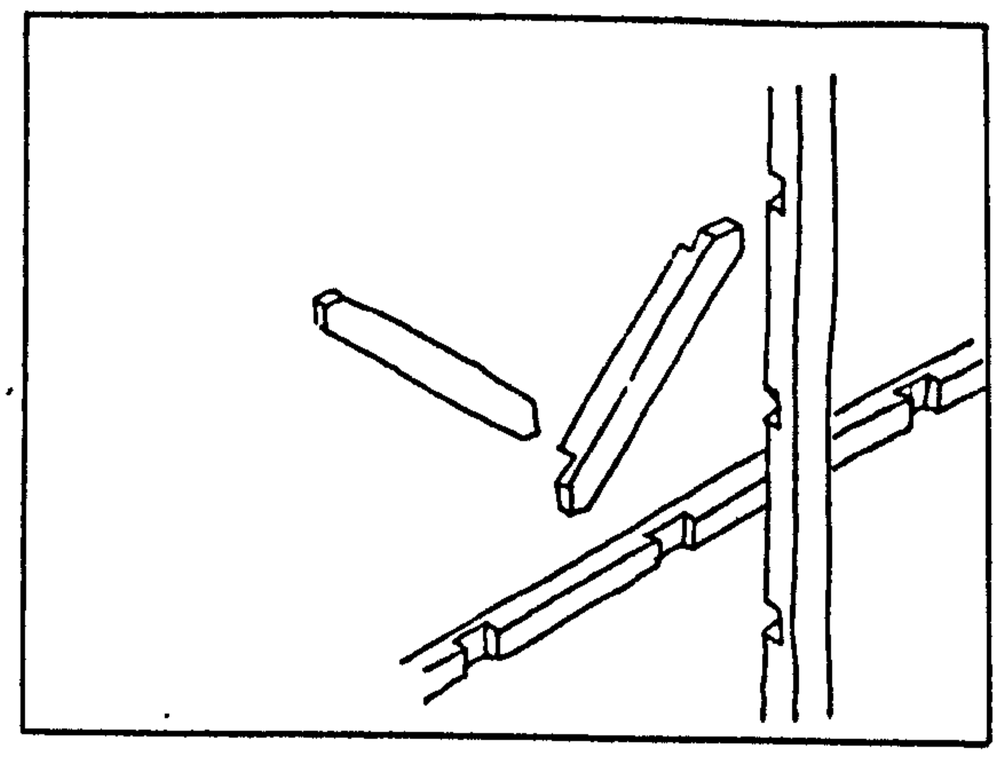
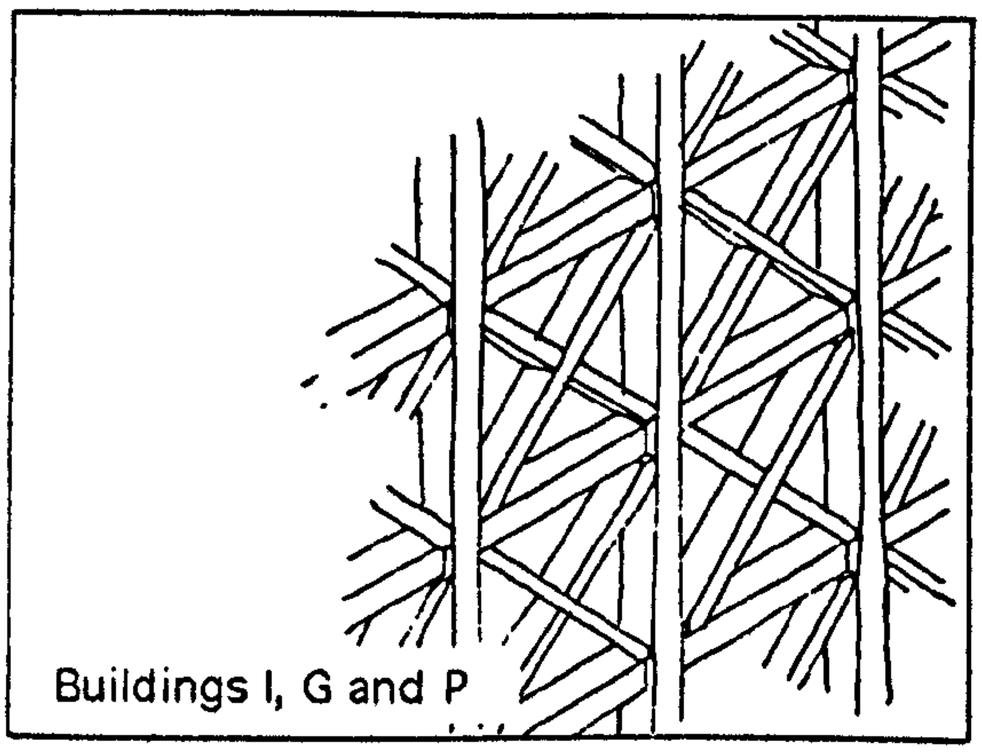


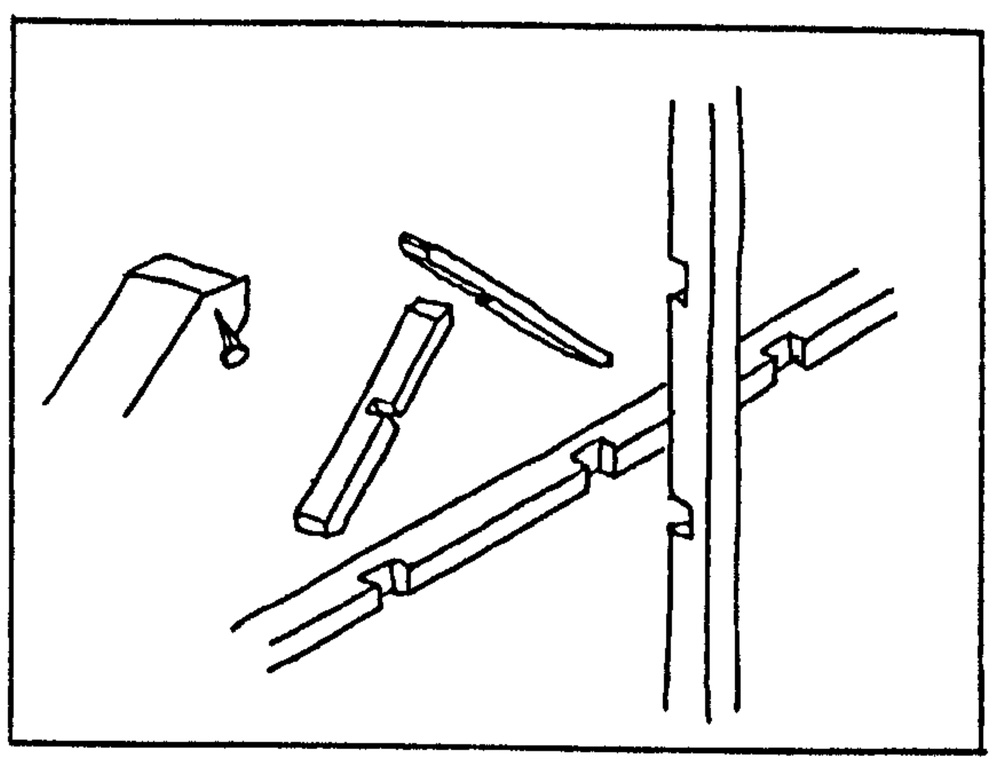
Fig.3.19-The cage on the stairs, (building B).

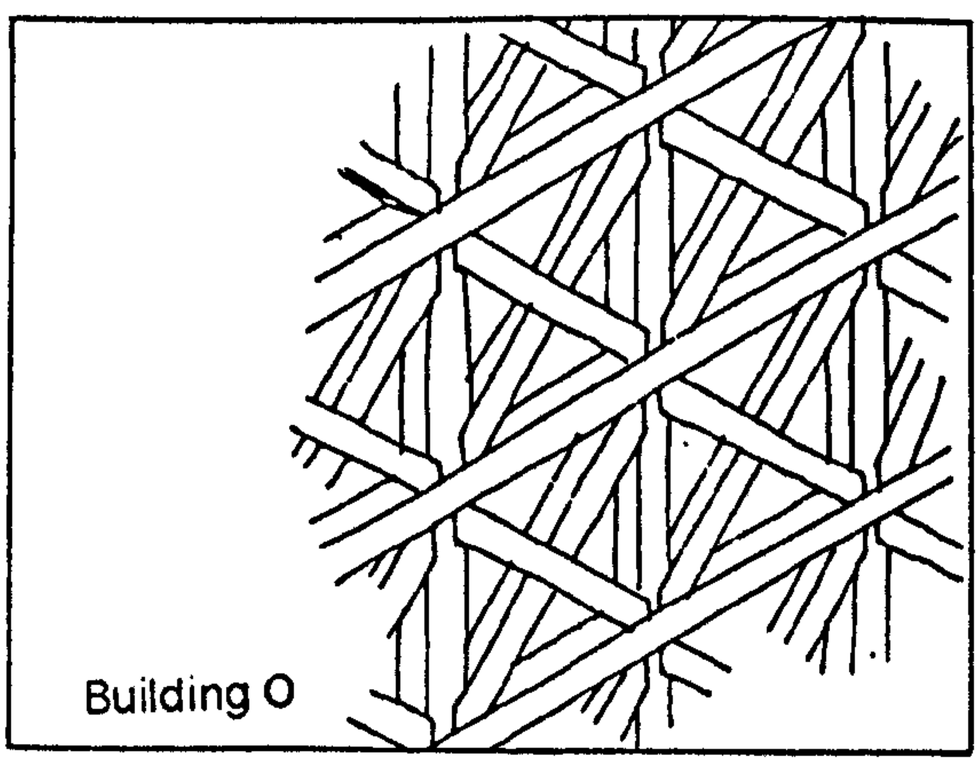
Details of the cage can be different (see Fig.3.20, 3.21 and 3.22) using complex connections (building G) (see Fig.3.23) or can have simplified connections using just nails and even round sections (building L) (Fig.3.24).

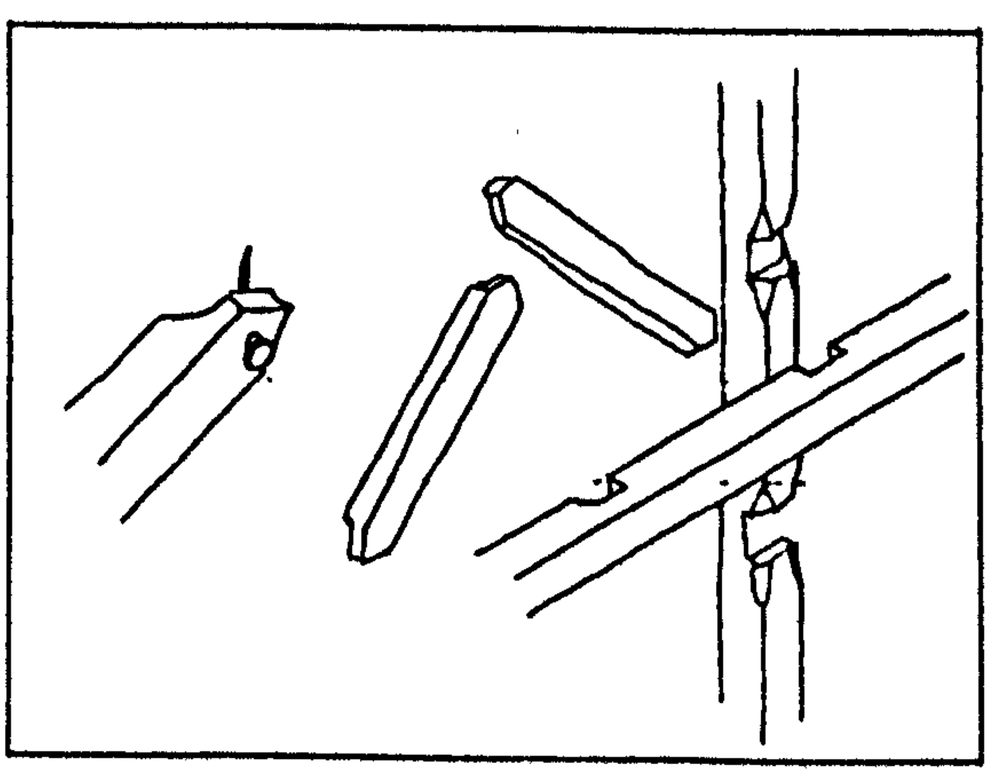


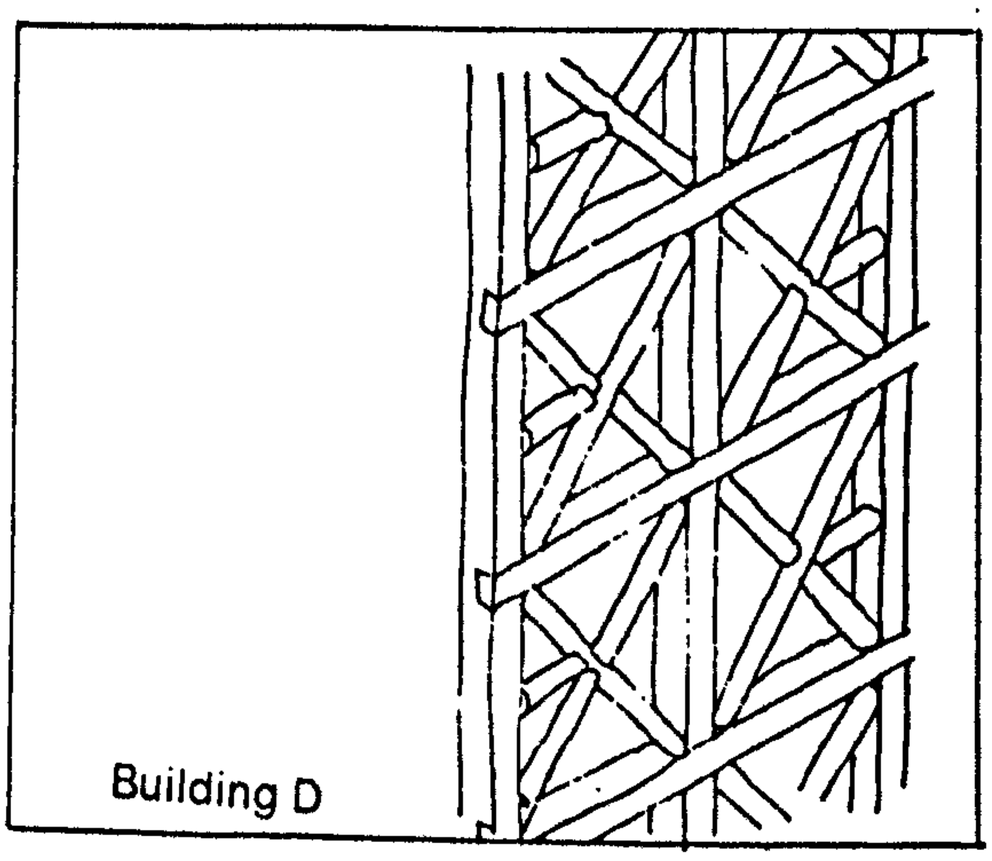












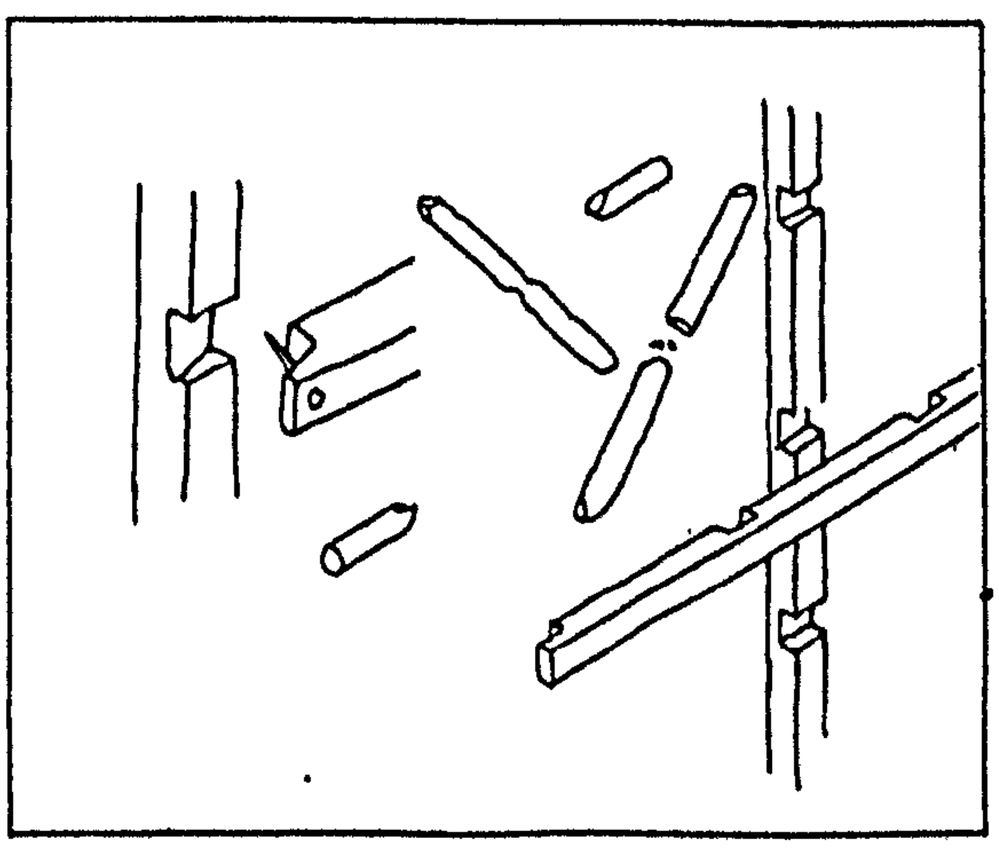
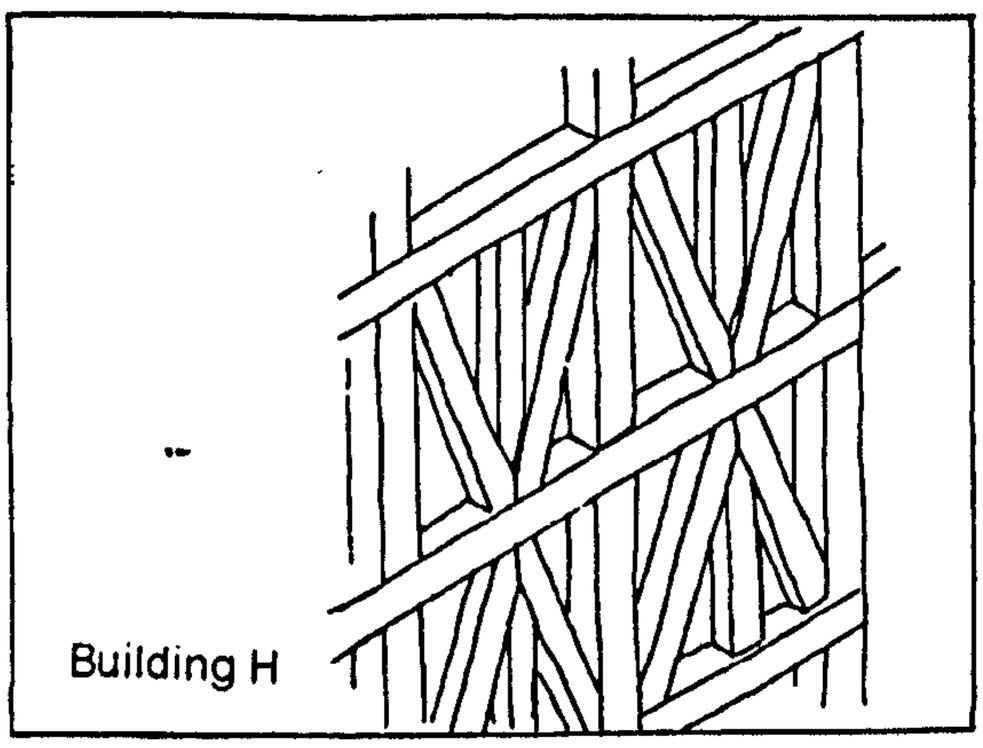
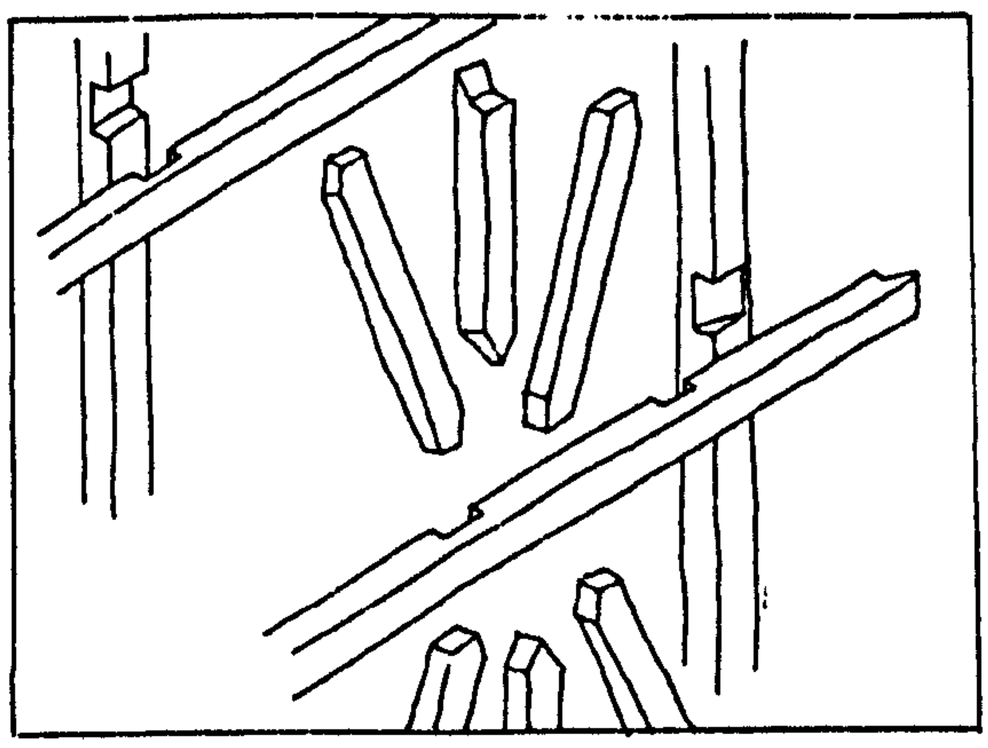
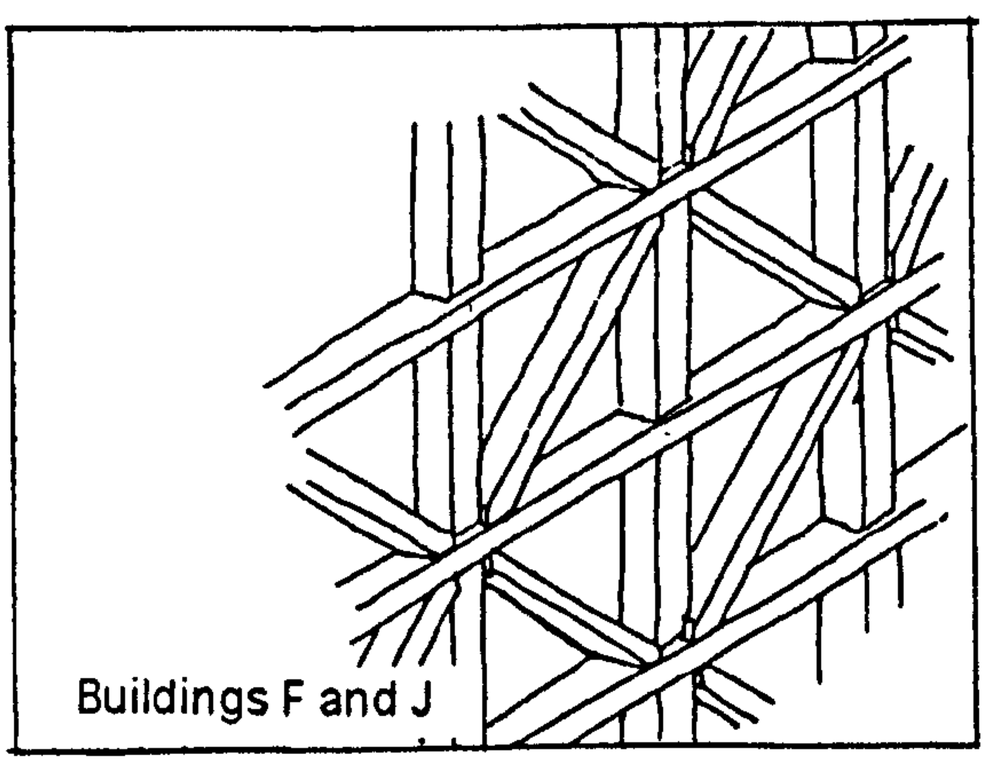
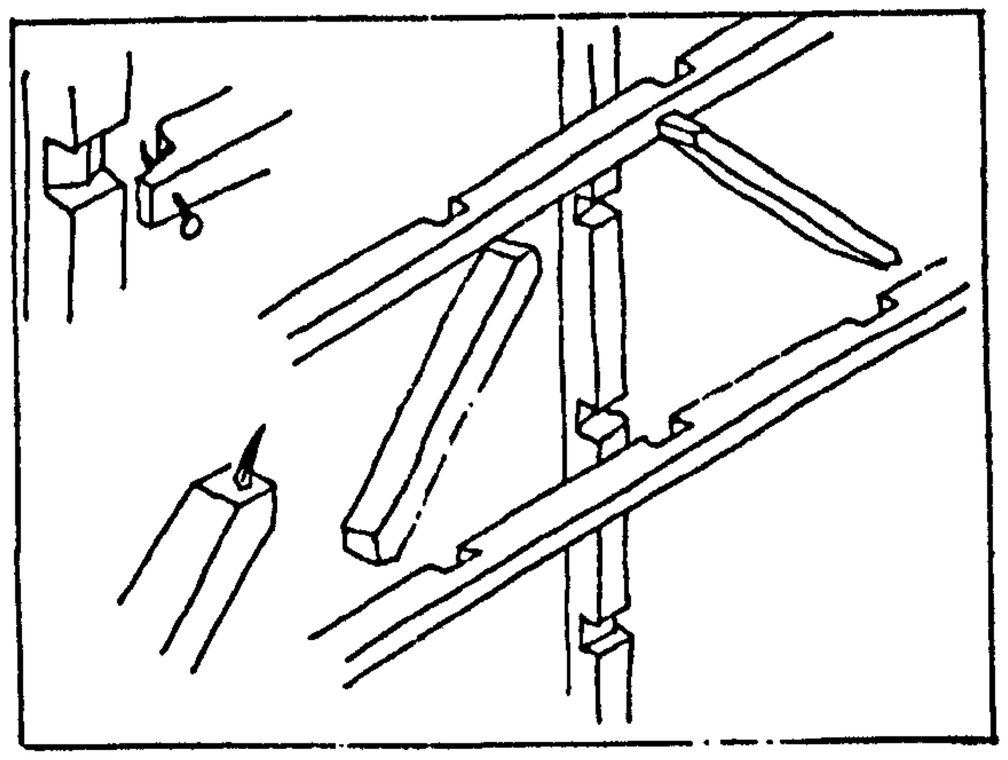


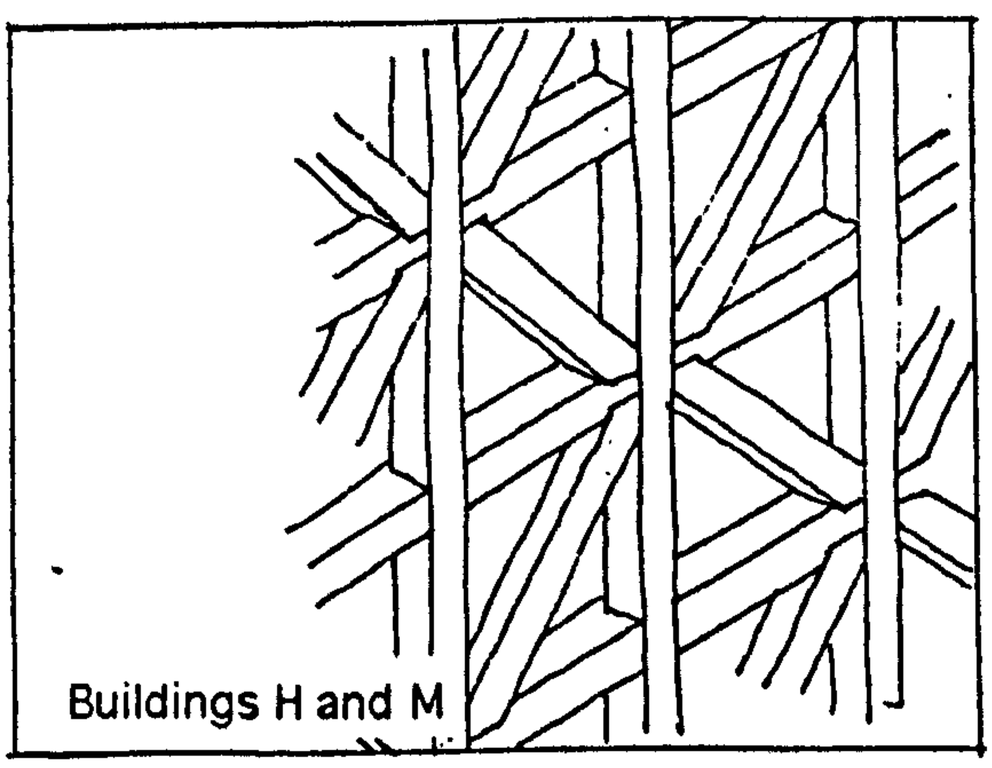
Fig.3.20-Different types of structures and connections 1

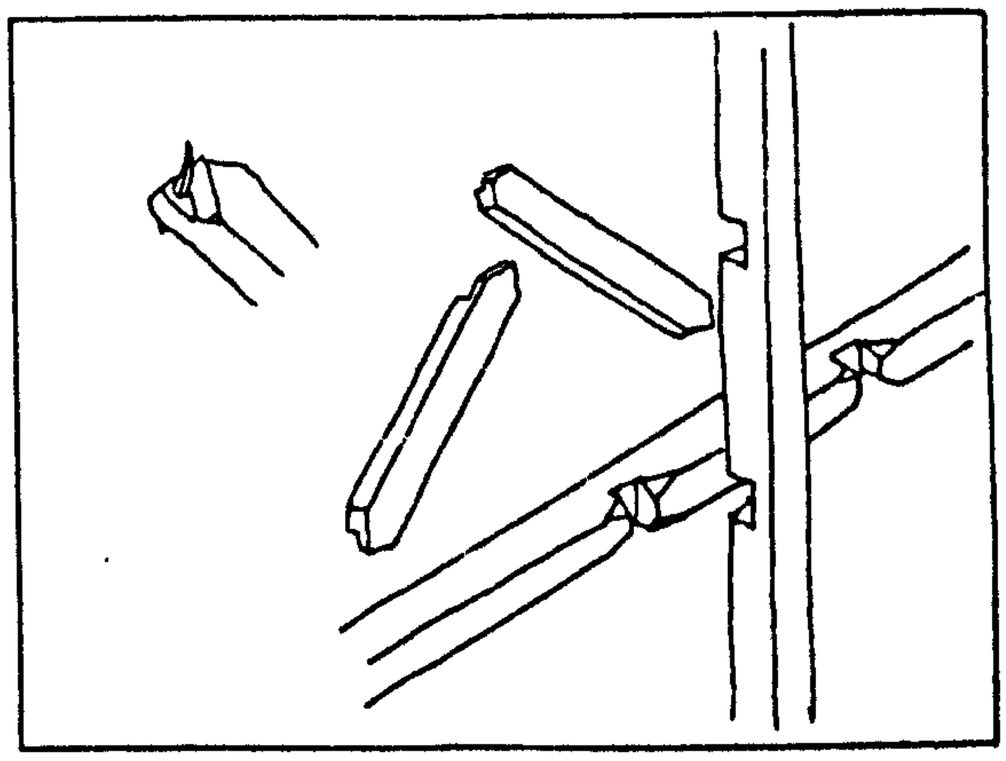


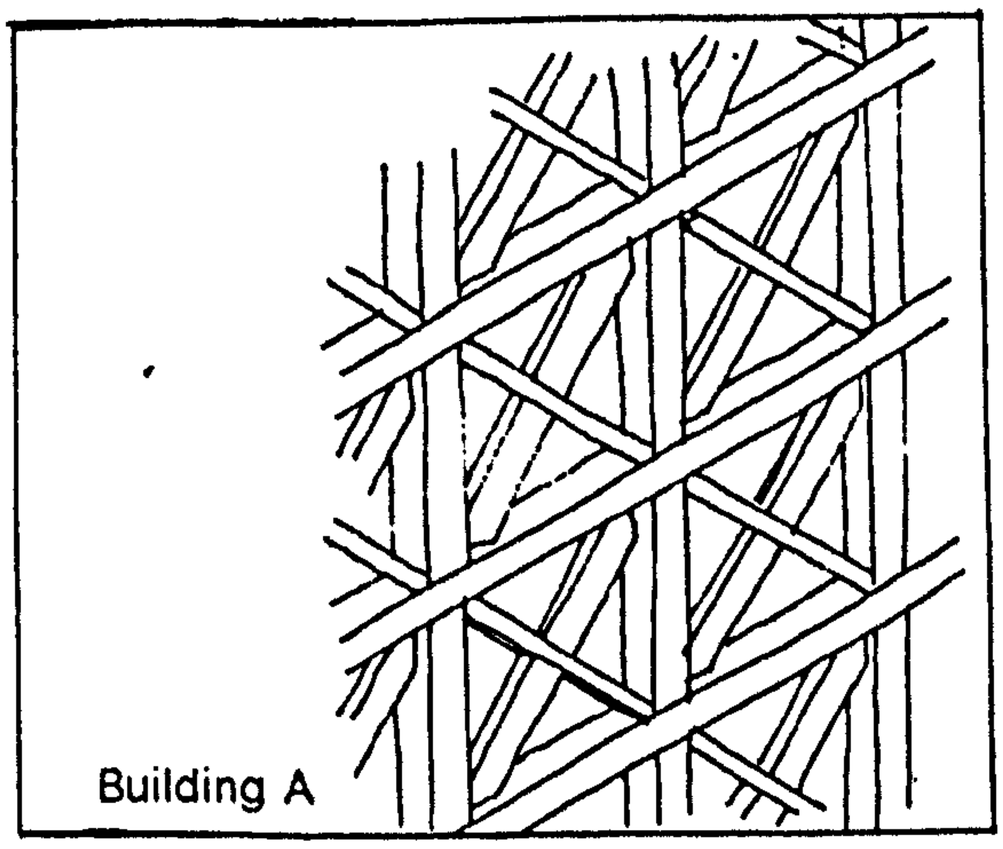












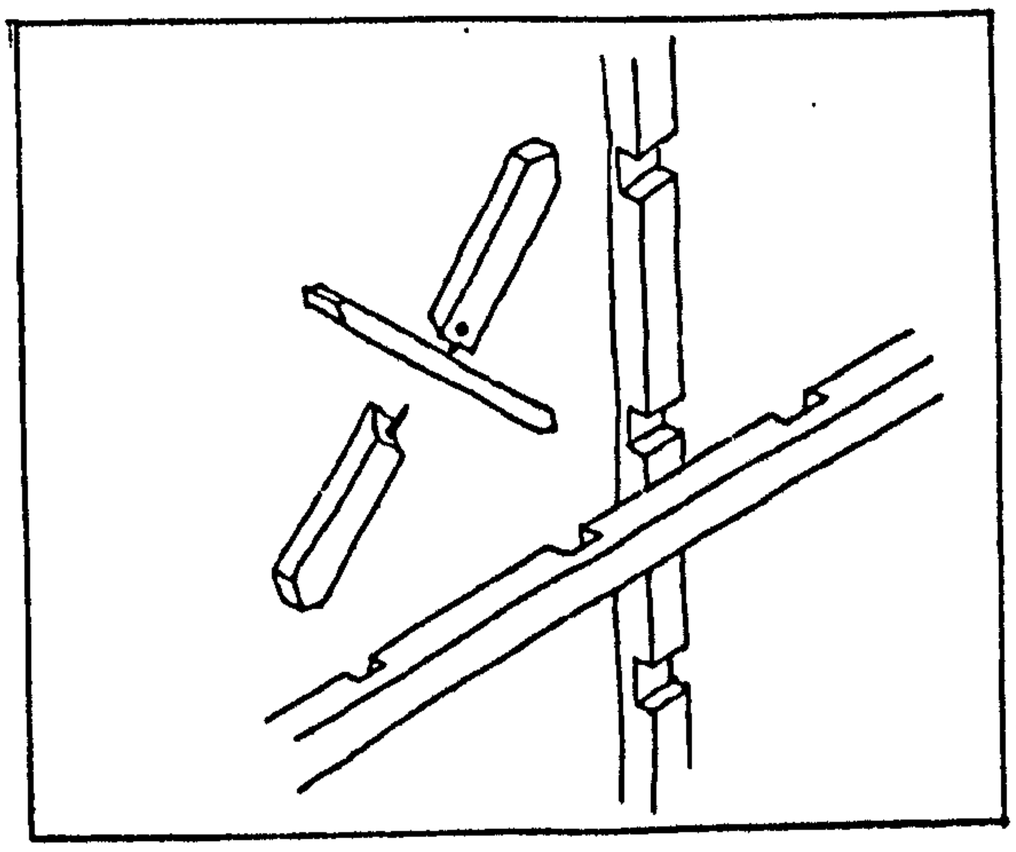
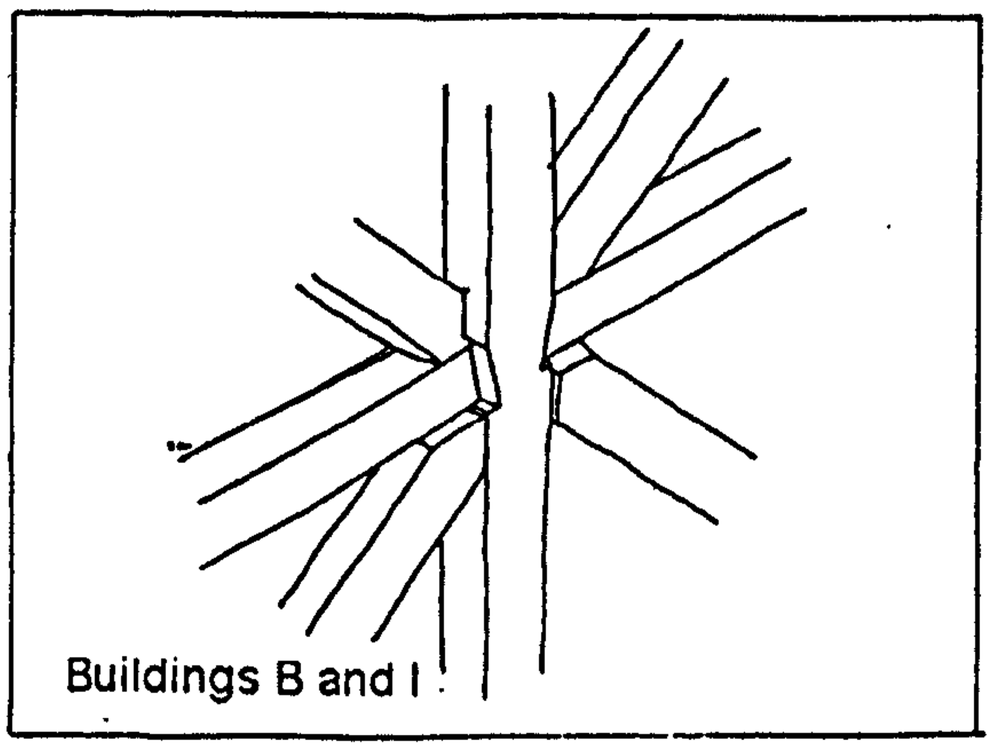
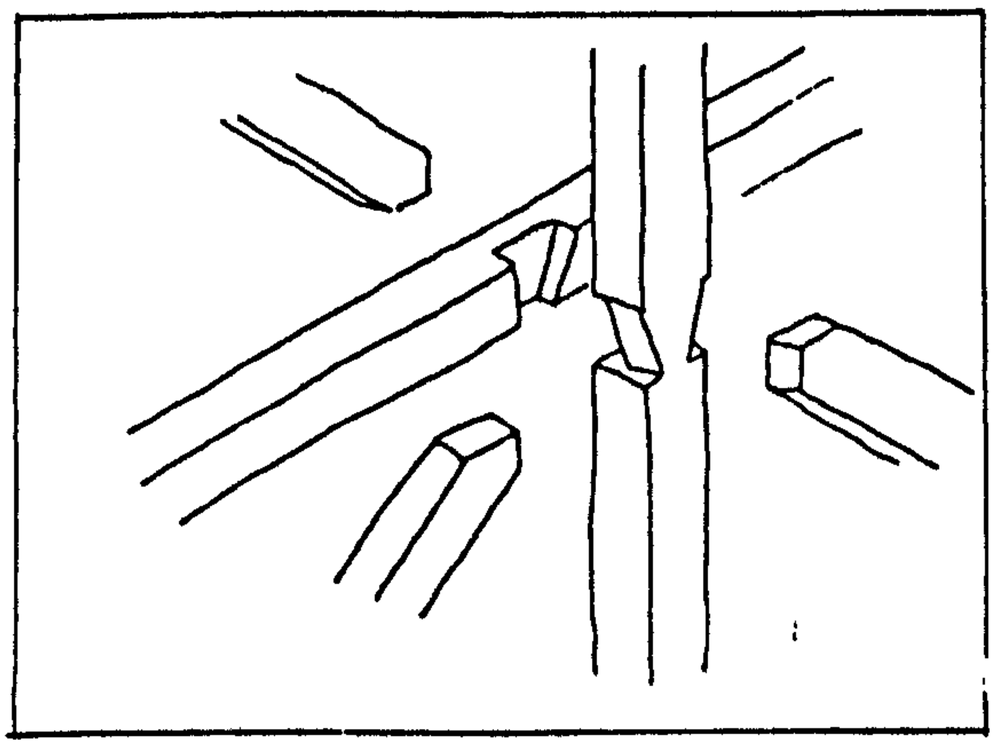
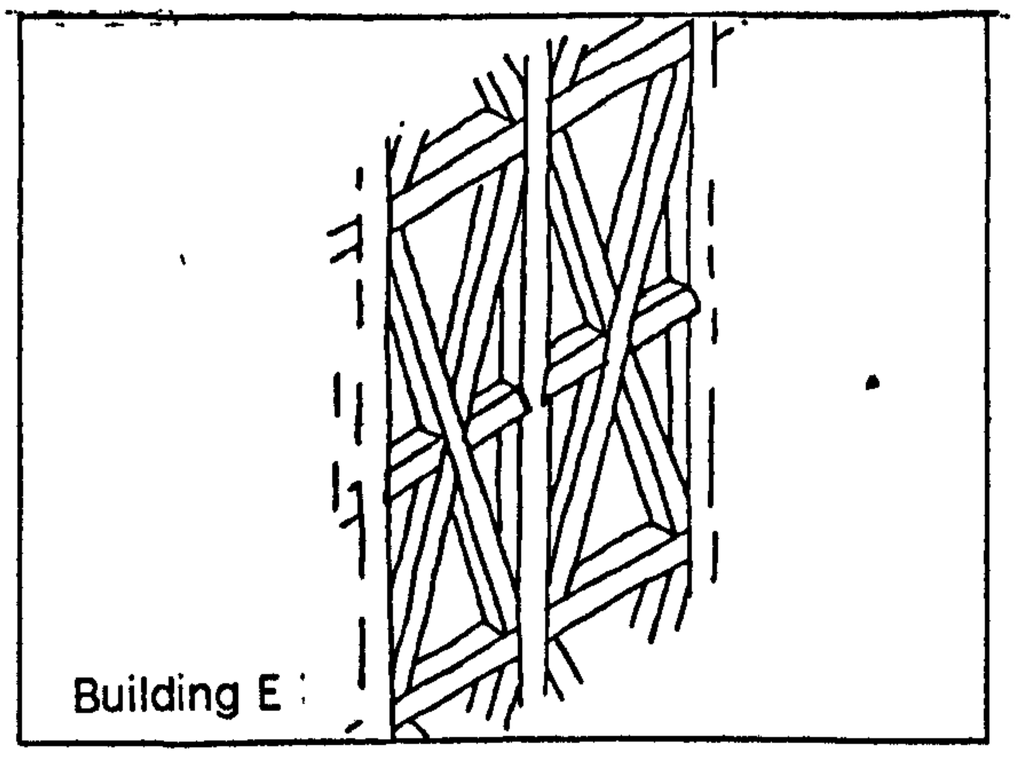
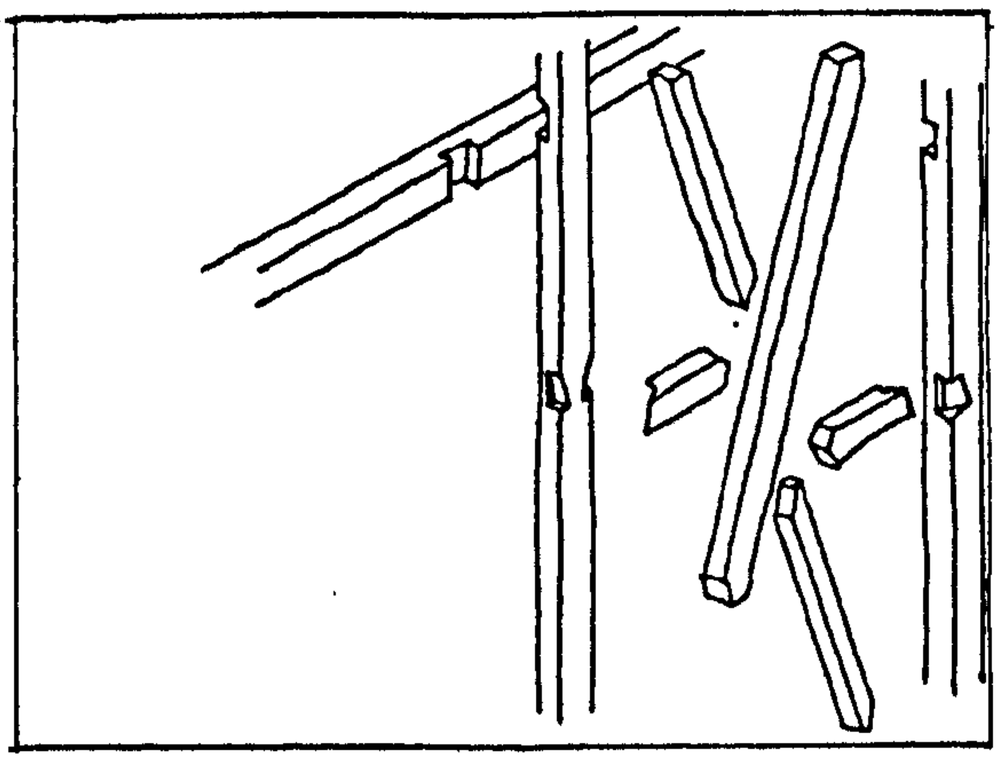


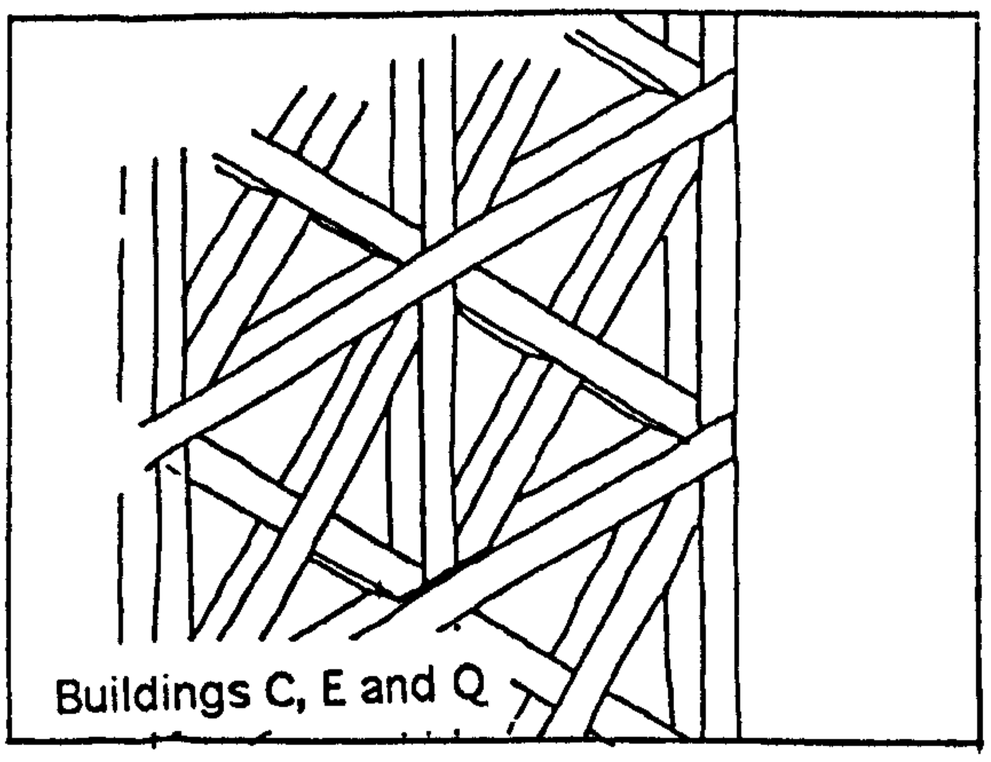
Fig.3.21-Different types of structures and connections 2

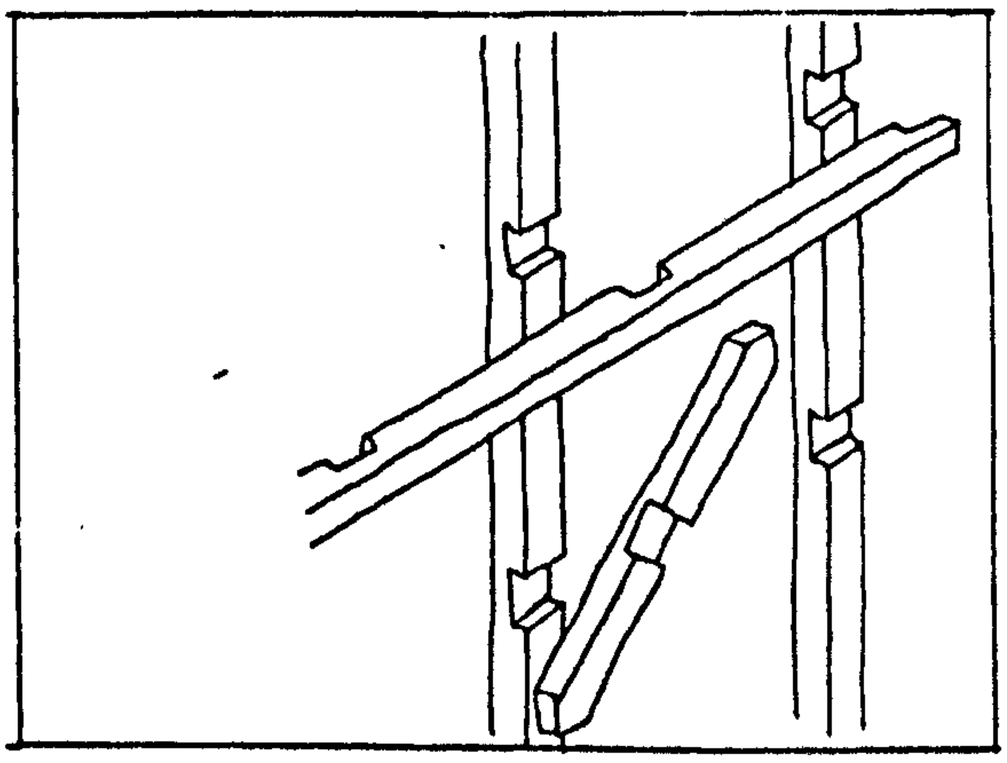


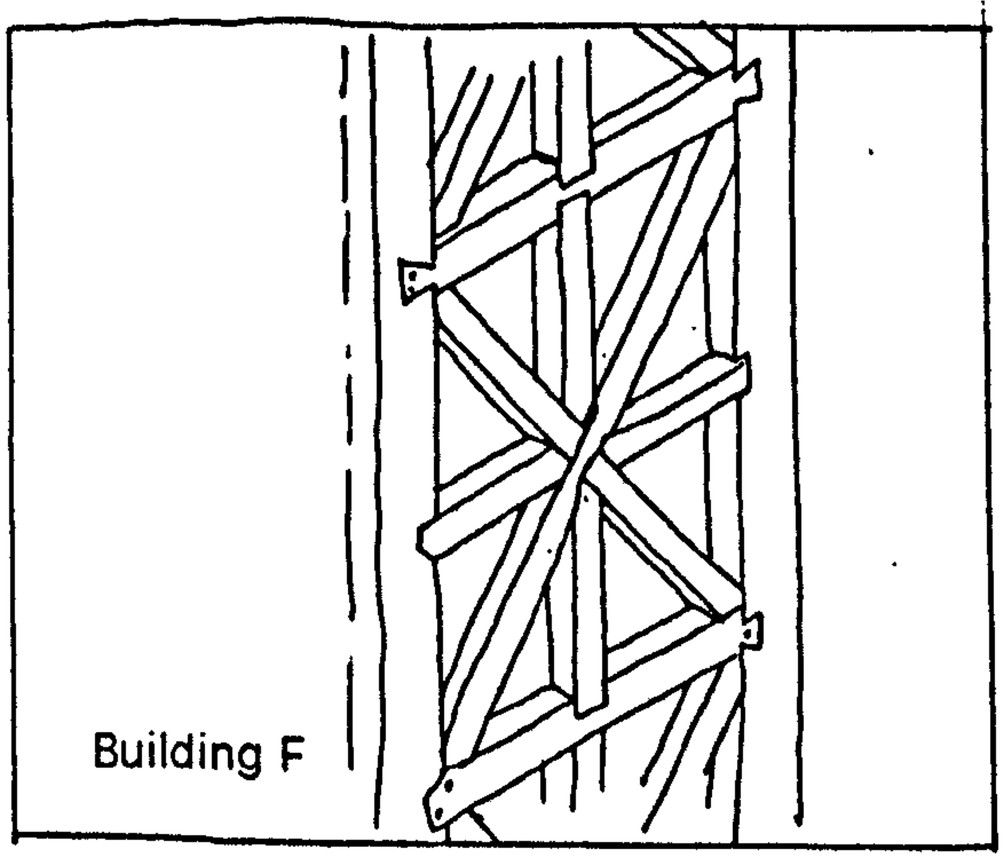












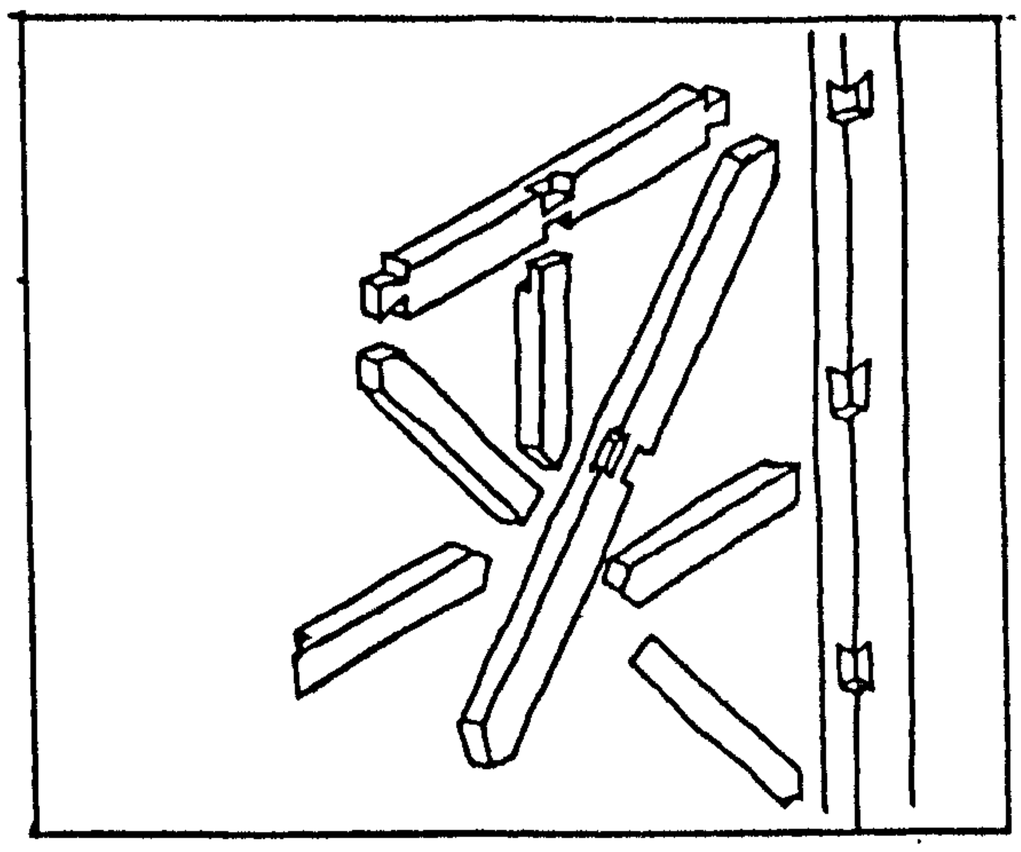


Fig.3.22-Different types of structures and connections 3

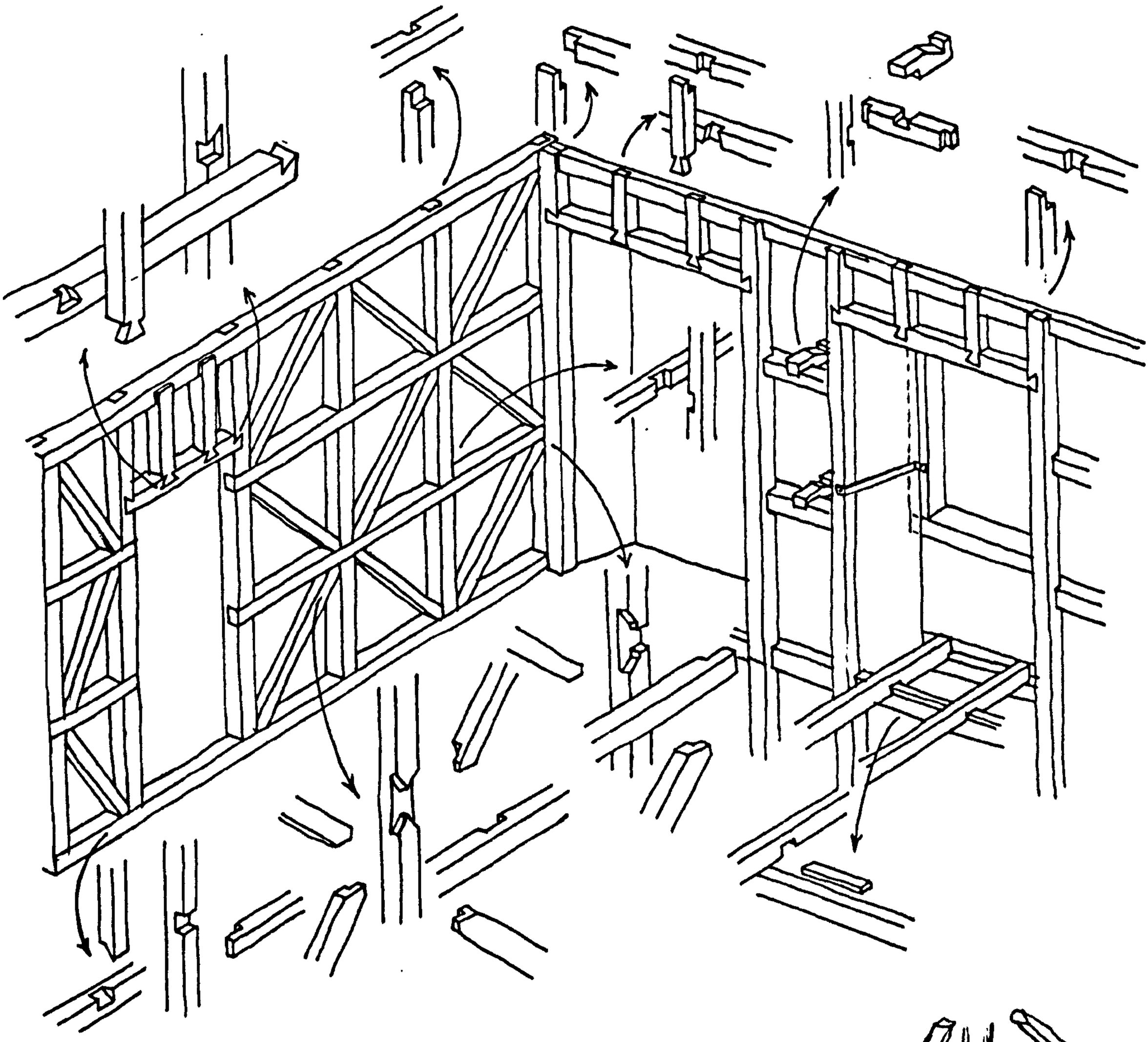


Fig.3.23-Example of details of a cage

Doorways were preferably formed in the middle of a panel, care being taken to ensure there were complete modules on either side so that there would be a more stable structure without it being necessary to place struts in the space for the fanlight. When a doorway was formed at the end of a panel, the fanlight area was strengthened by diagonal struts (building B)(see Fig.3.25).

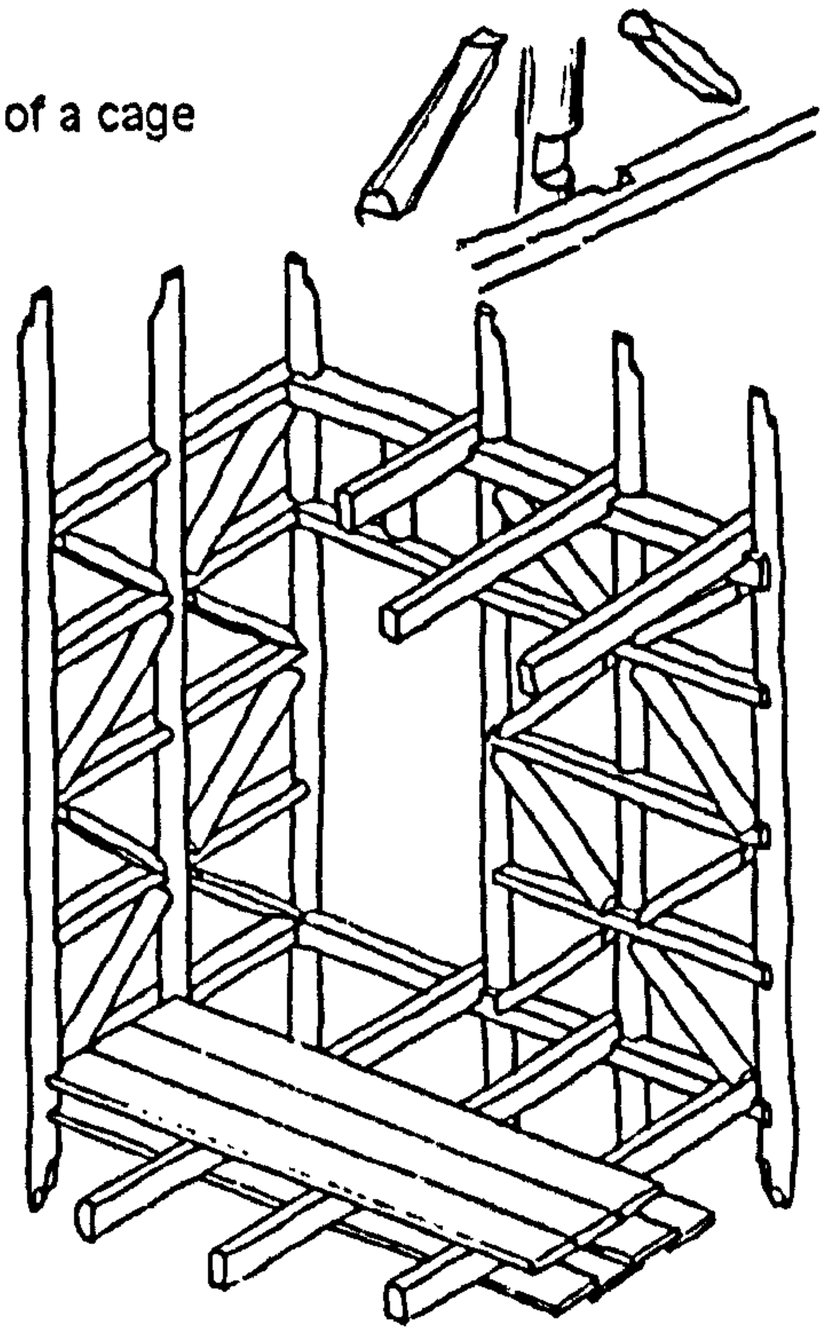


Fig.3.24- Example of a less elaborate cage

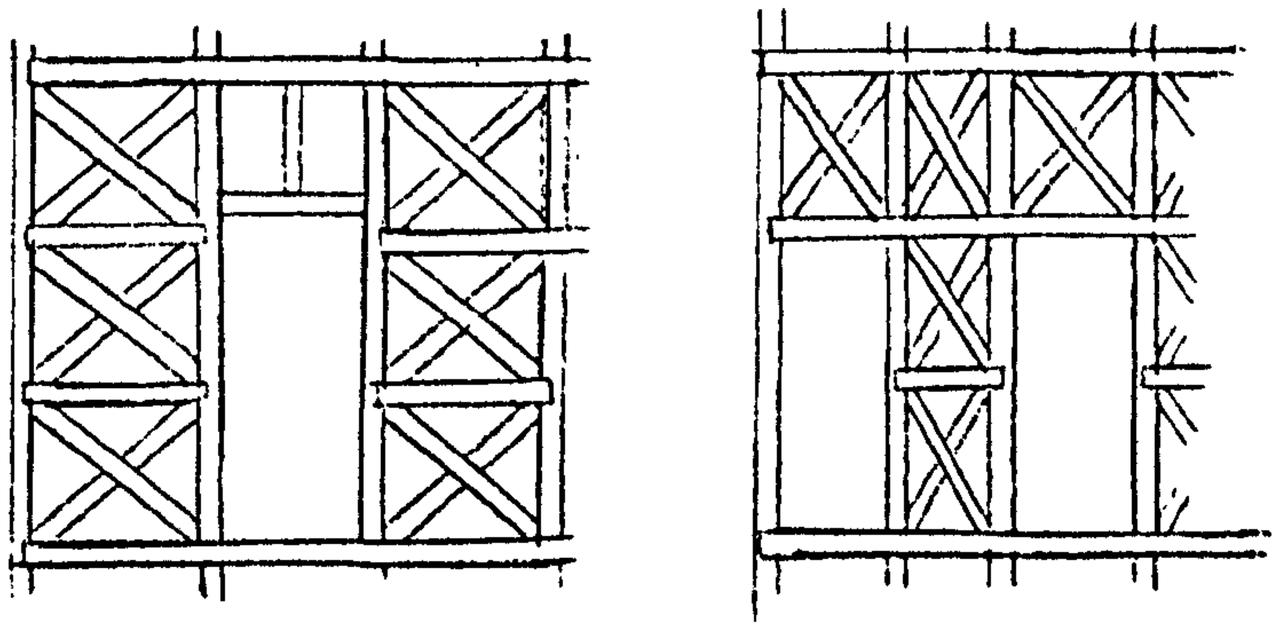


Fig.3.25-Doorways formed in panels

Where workmanship is better the panels are covered with wooden lath and plaster (building L) (Fig.3.26), making the internal walls virtually hollow and light in weight. In the event of an earthquake the finish would disintegrate without harming the residents unduly and the *gaiola* would retain its elasticity in order to withstand the earthquake, (building L) (Fig.3.28). In other cases the interiors of the panels are filled with stones and mud, (building C) (Fig.3.27)

The party and external walls were built of stone with the *gaiola* structure within them but on their inner surface in order to avoid destruction if the stone wall collapsed.

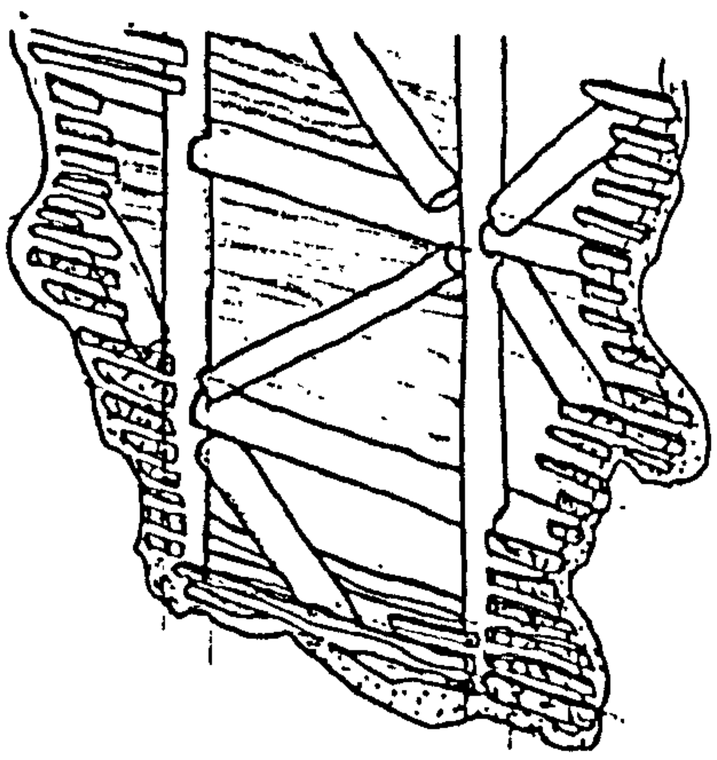


Fig.3.26-Panels covered with lath and plaster

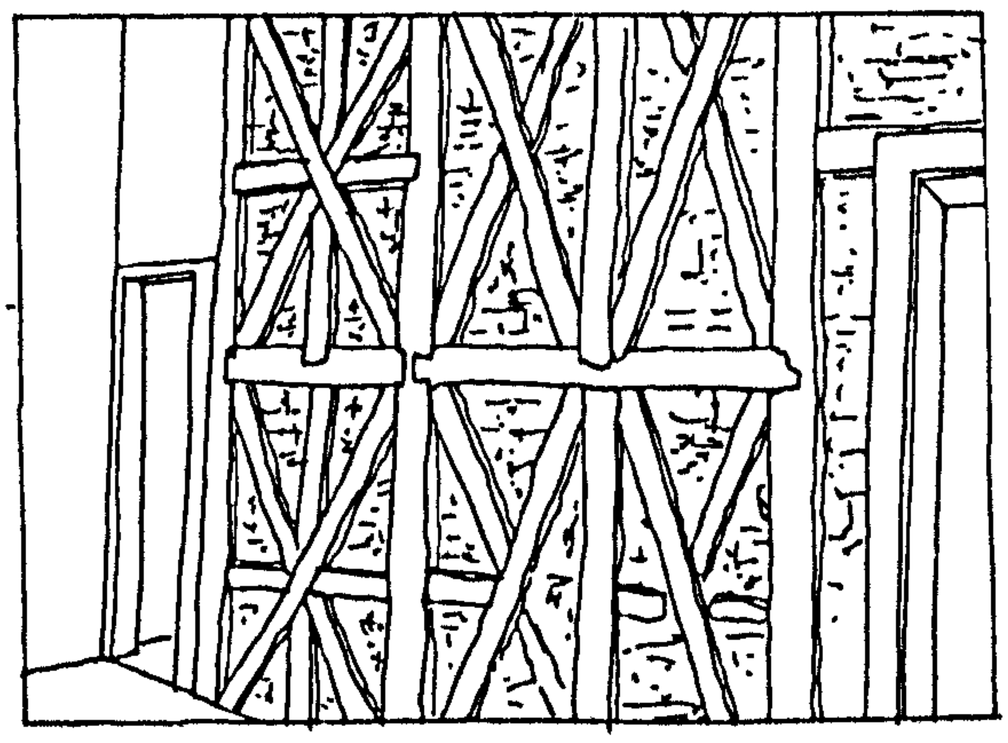


Fig.3.27-Panels infilled with stones and mud.

The connections between the various oak and pine struts in the structure were flexible, which meant that in the event of an earthquake, the whole structure could adapt to the movements of the land, such movement as would be facilitated by any rigidity in the joints. Although great deformation would be limited by the triangulation of the *gaiola*, it would stay upright and still support the wooden floors, even though the plasterwork would crumble.

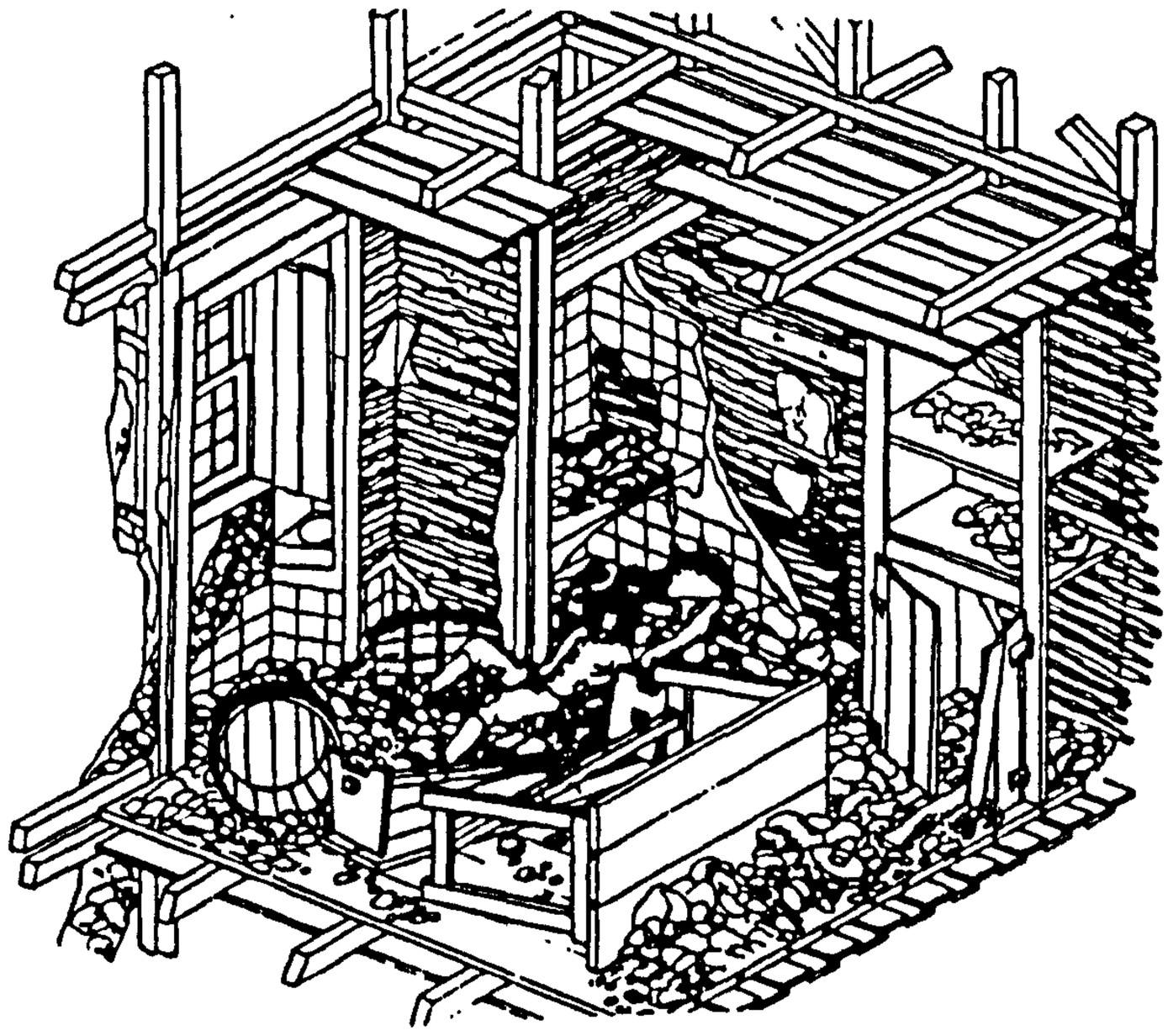


Fig.3.28-The structure after the earthquake

The section dimensions of the *gaiola* members varied with the species of timber used and the location, with larger sections generally being used for lower floors. The following dimensions are typical for pine members in major buildings:

Posts 12 x 10 cms.

Beams 12 x10 cms (upper floors) or 15 x12 cms (lower floors).

Noggings 12 x16 cms

Diagonals 7 x 10 (lower floors) or 10 x10 cms (upper floors).

Chestnut and oak members, normally located near the windows or in the roofs, have different dimensions (buildings A, C, E, G and H), for example the diagonals are longer (Fig.3.29).

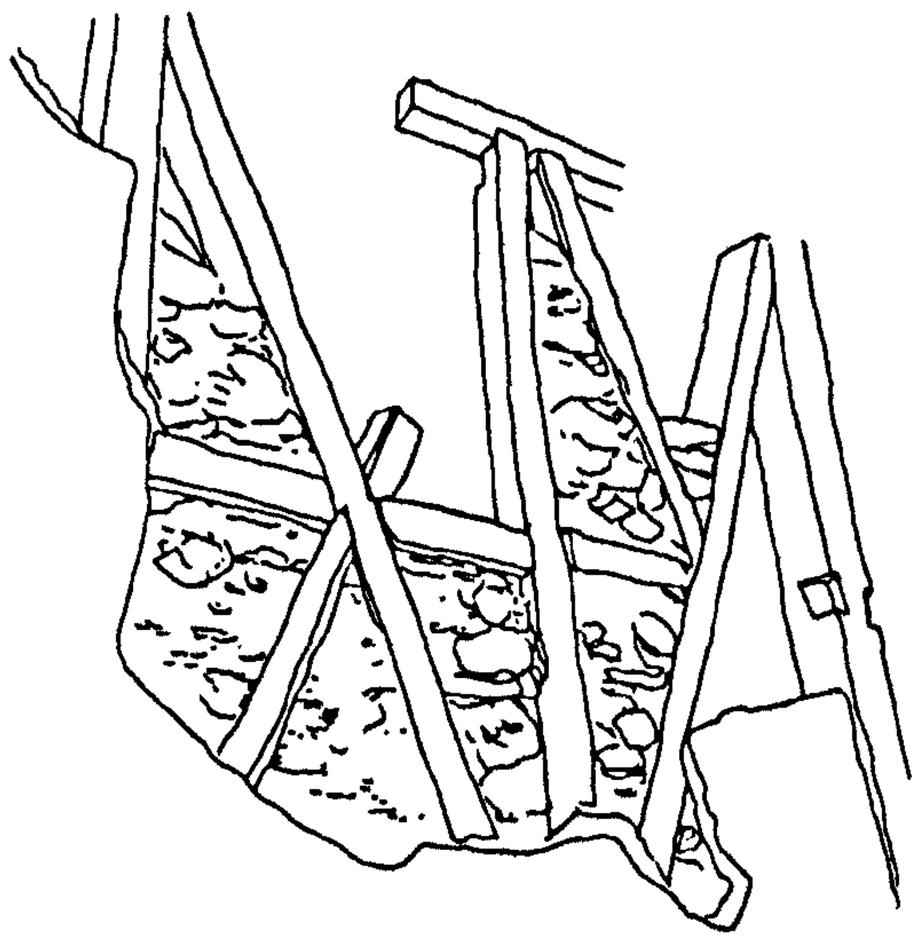
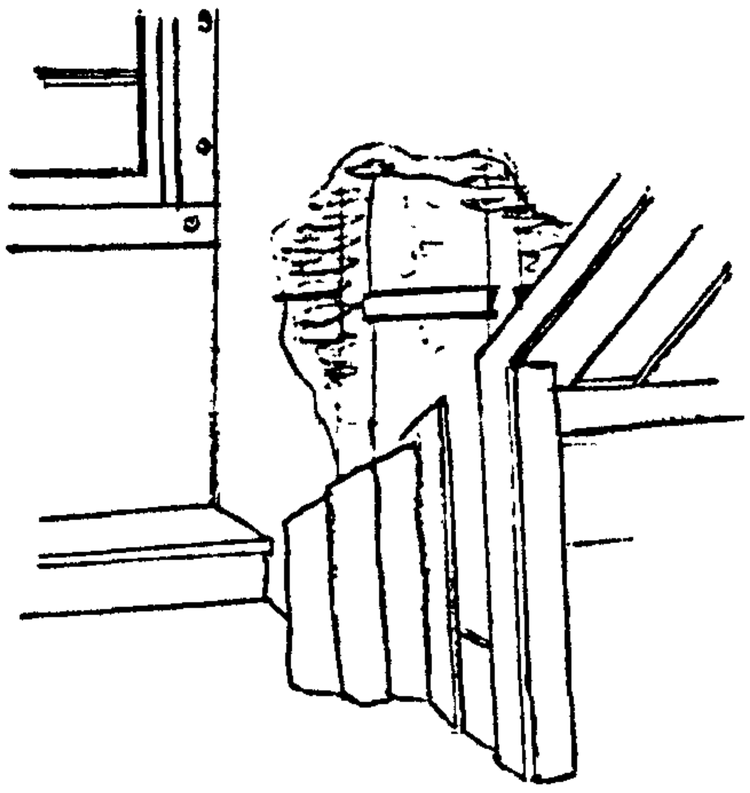


Fig.3.29-Diagonals in chestnut

On the attic floor, the sizing of the timber sections was extremely inconsistent (buildings A, C, E, G and H). The sections were always smaller and irregular and often consisted of small, circular logs which even had bark left on them(Fig.3.30)



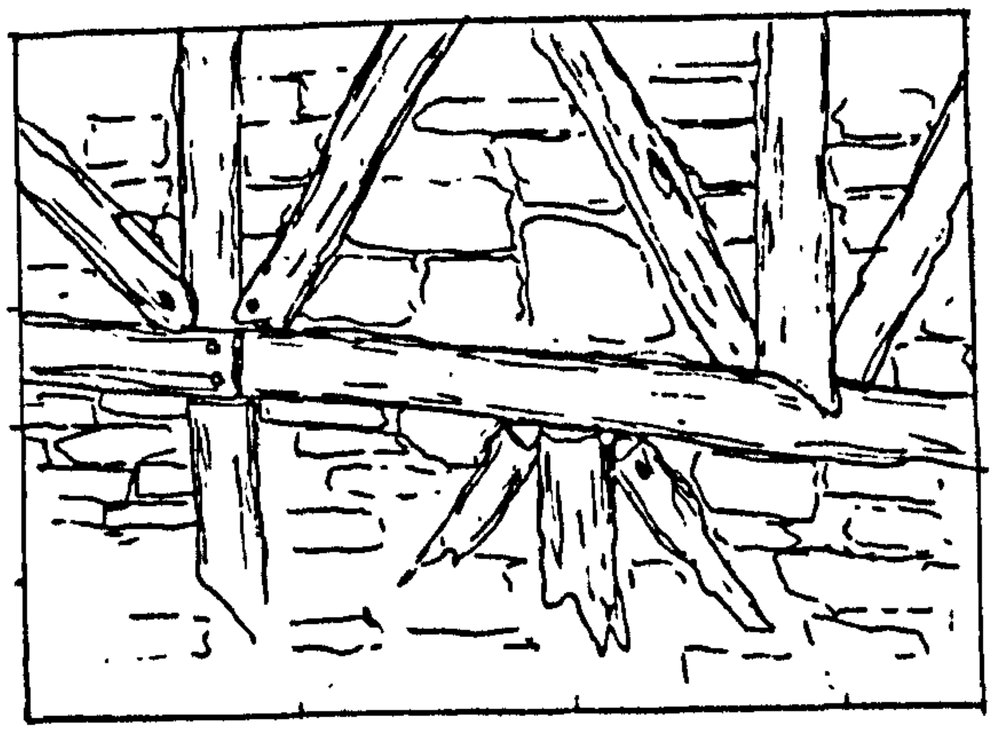


Fig.3.30-Example of the type of structure found on the attic floors.

The posts and studs are extended upwards using a *topo de gazepe* (scarf joint) reinforced with an iron staple, (buildings P) (Fig.3.31), or using a nogging placed between two floor joists, with a built up joint rather than a scarf joint between the two lengths of stud and with or without an iron staple (buildings A, F and G) (Fig.3.32).

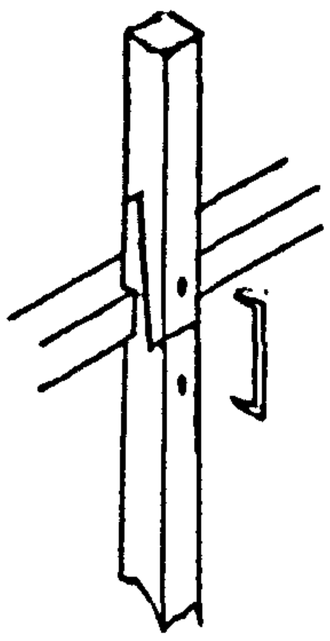


Fig.3.31-Extension of a stud with "*topo de gazepe*" or stapled scarf joint.

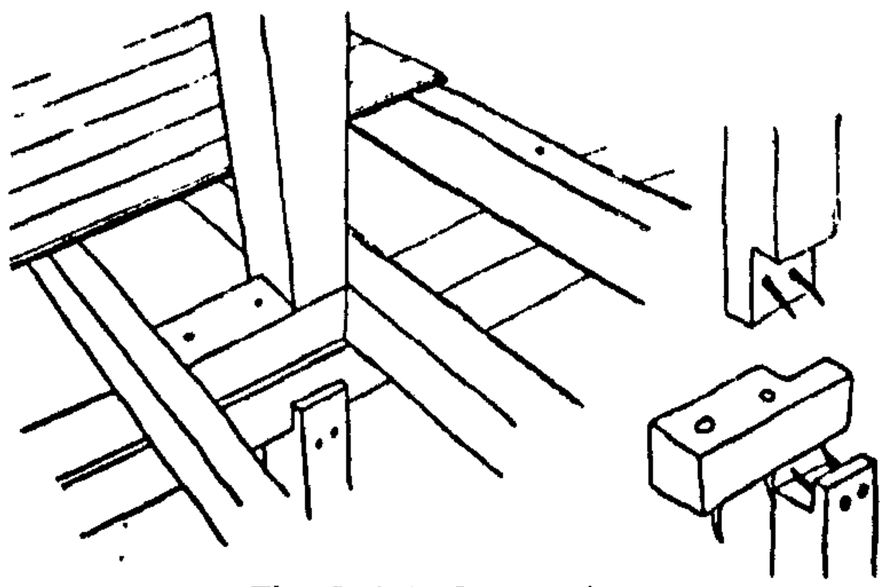


Fig.3.32-Extension of a stud using a nogging.

When panels in adjacent storeys are aligned, they have a common beam at or just below floor level, (buildings A, F and G) (Fig.3.33, 3.34, 3.35 and 3.36).

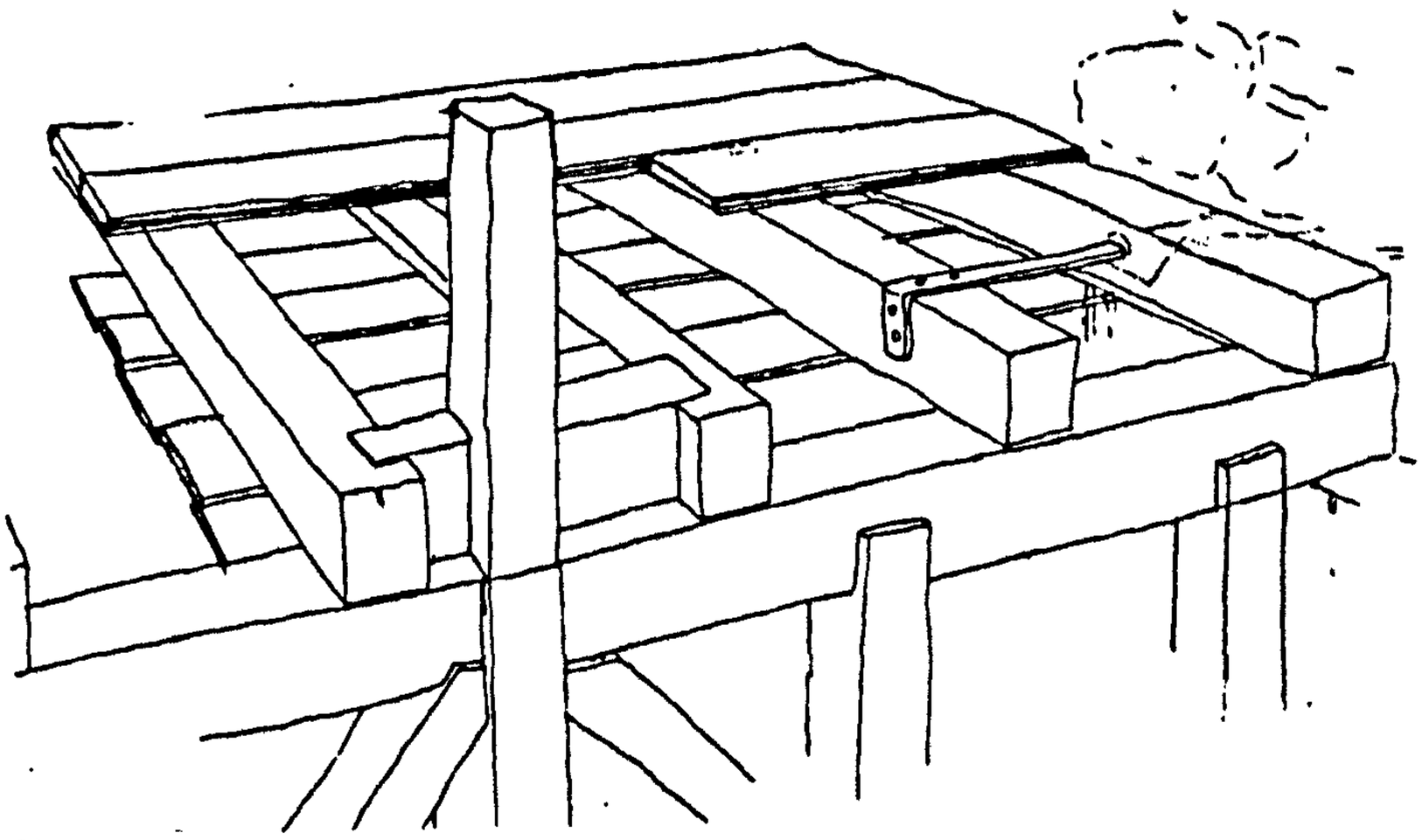


Fig.3.33-Example of connections between vertical and horizontal elements

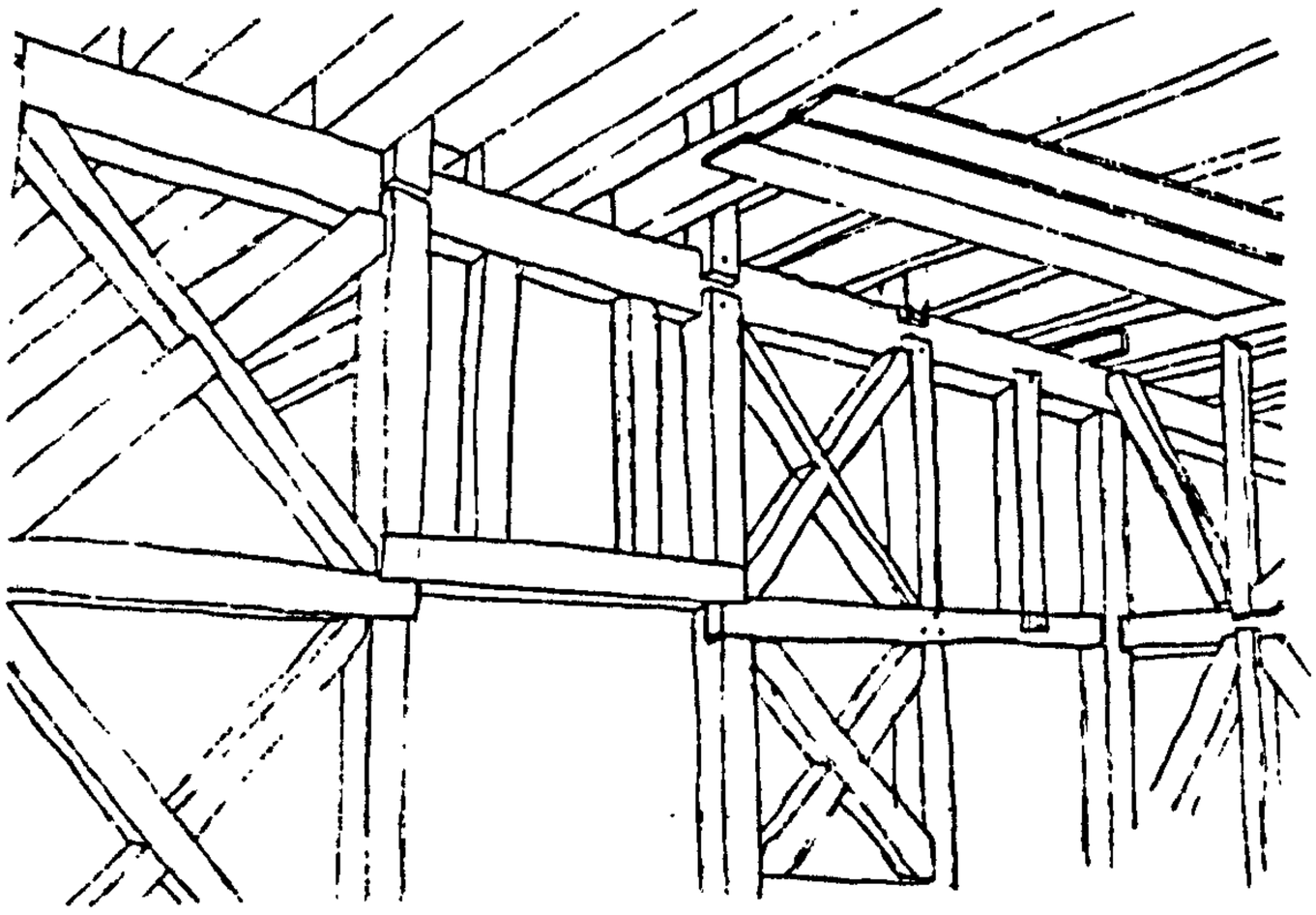


Fig.3.34-Example of connections between vertical and horizontal elements

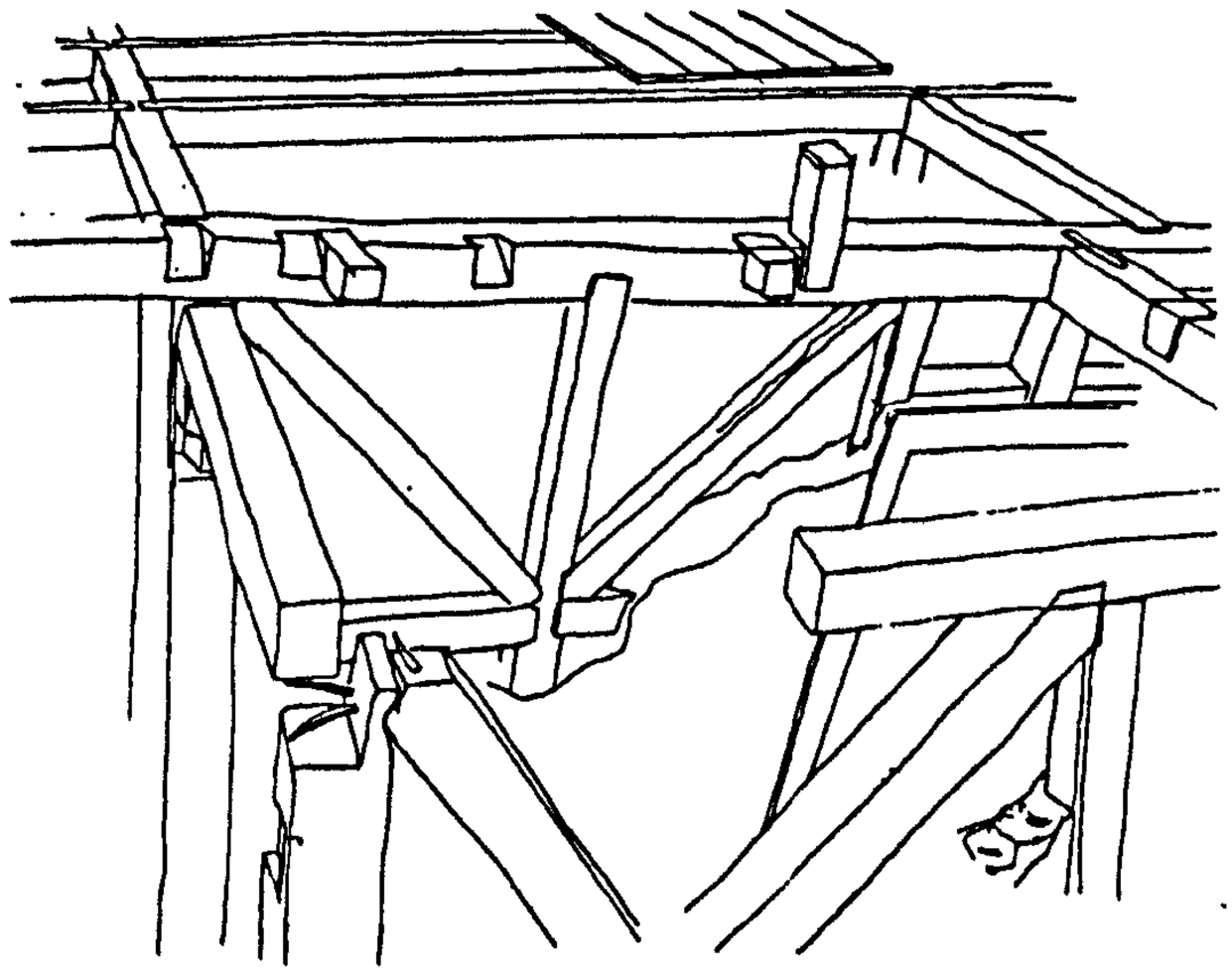


Fig.3.35-The panels of the upper and lower floor share the same beam.

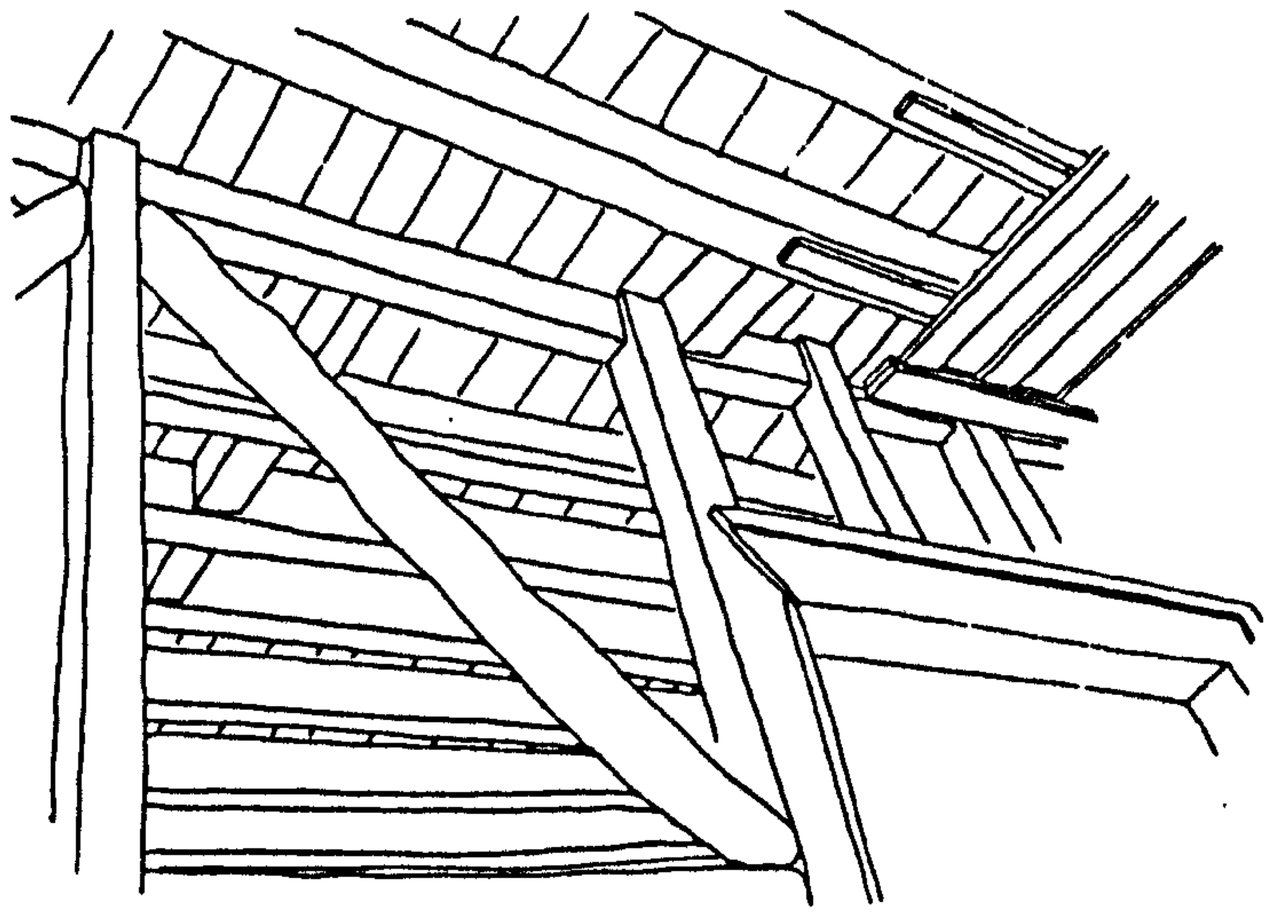


Fig.3.36-The panels of the upper and lower floor share the same beam.

In order to increase solidity, in all observed cases (buildings D), the floor joists are anchored to parallel walls with metal straps, (Fig.3.37).

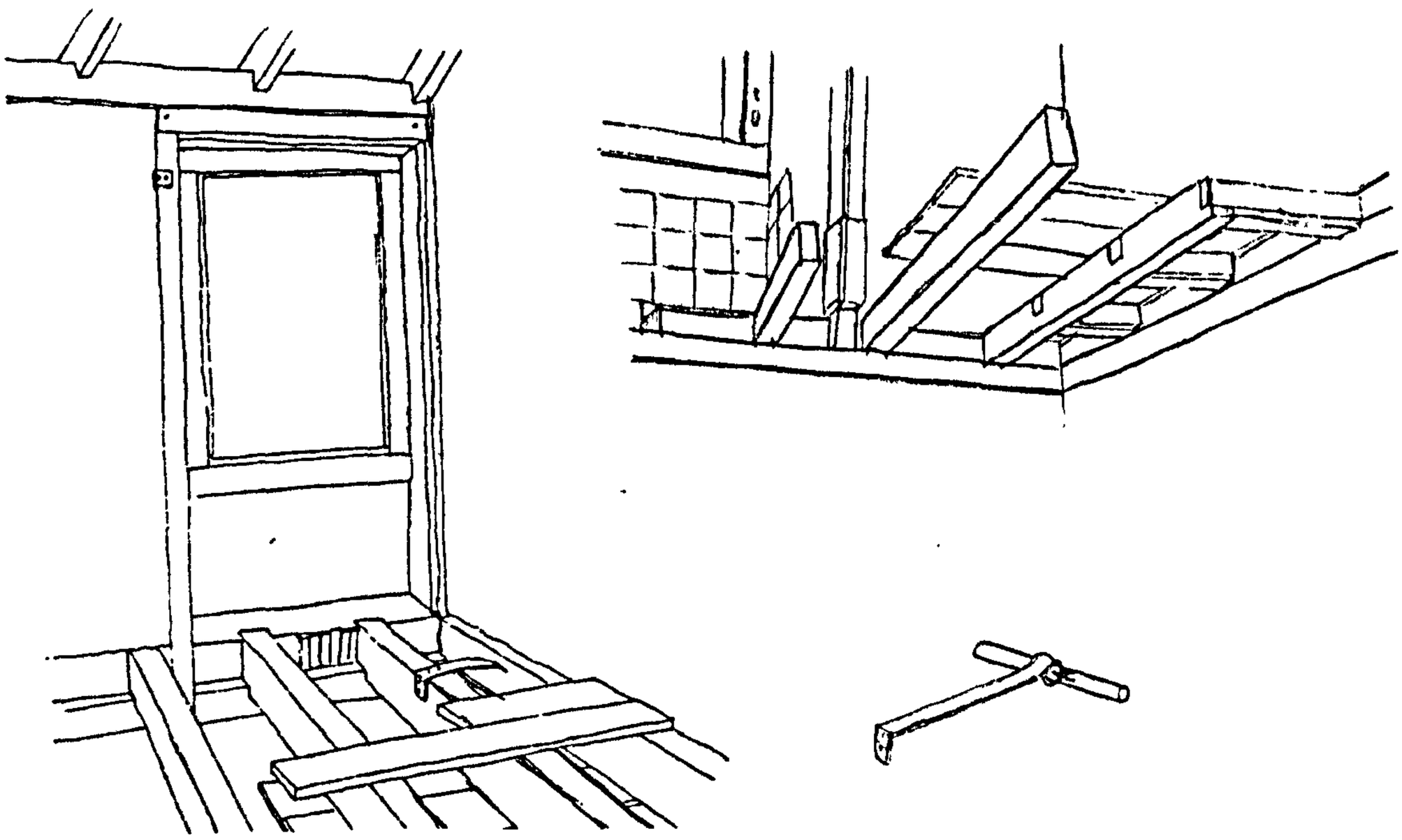


Fig.3.37-Examples of connections between floors and walls

The junctions of the panels are normally formed on the perpendicular with a T connection. The following are ways of achieving this (building B) (see Fig.3.38 and 3.39).

i.By using a thick post shared by the two panels (building F).

ii.By doubling up the studs at junctions (building G and B).

iii.By making a connection at an intermediate point between the studs of each panel, and connecting the noggings and diagonal struts of each panel to one another (building Fand G).

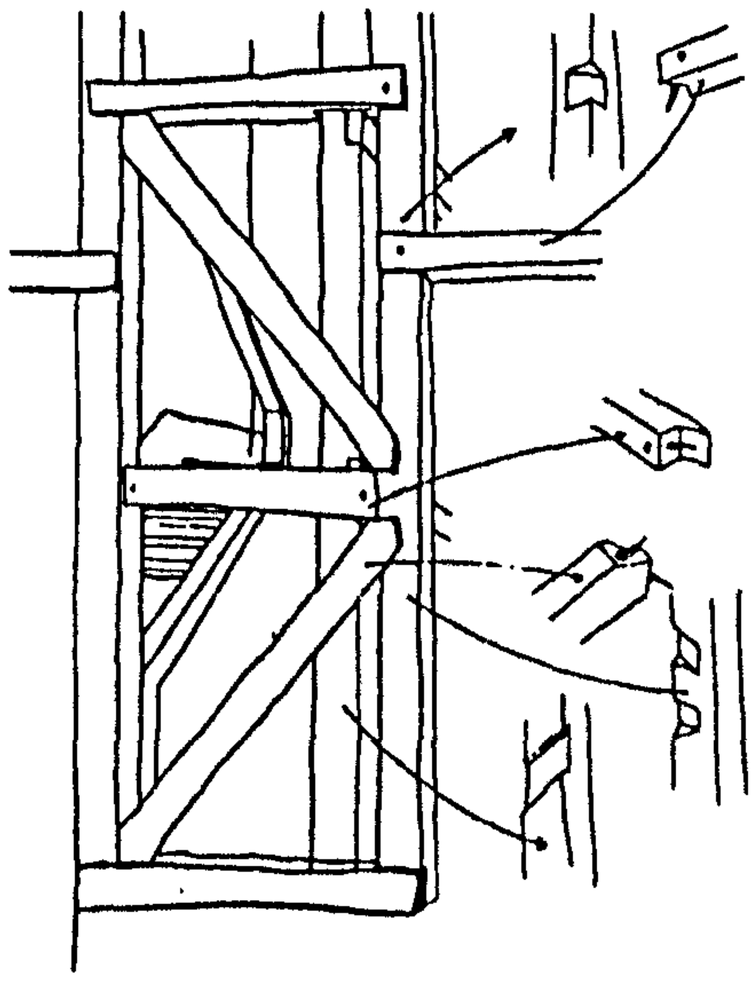
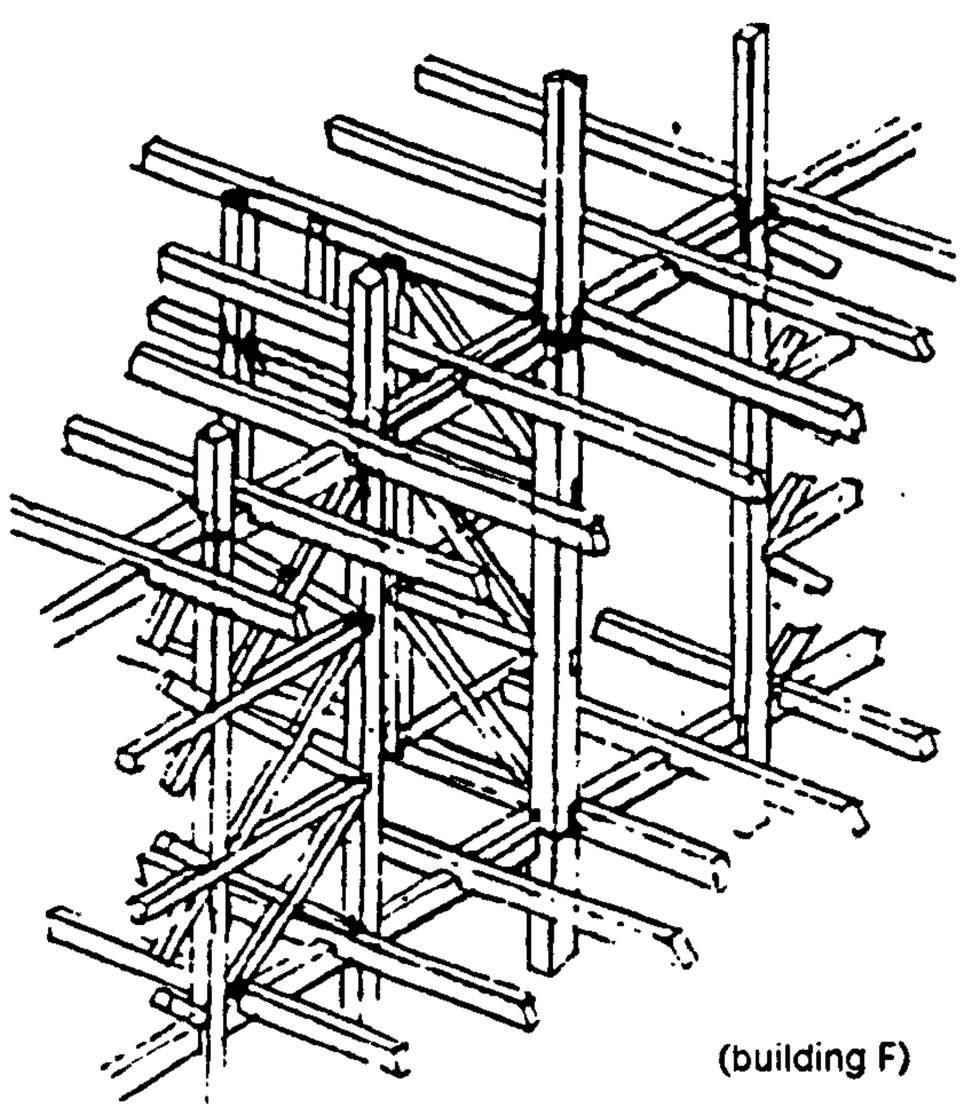
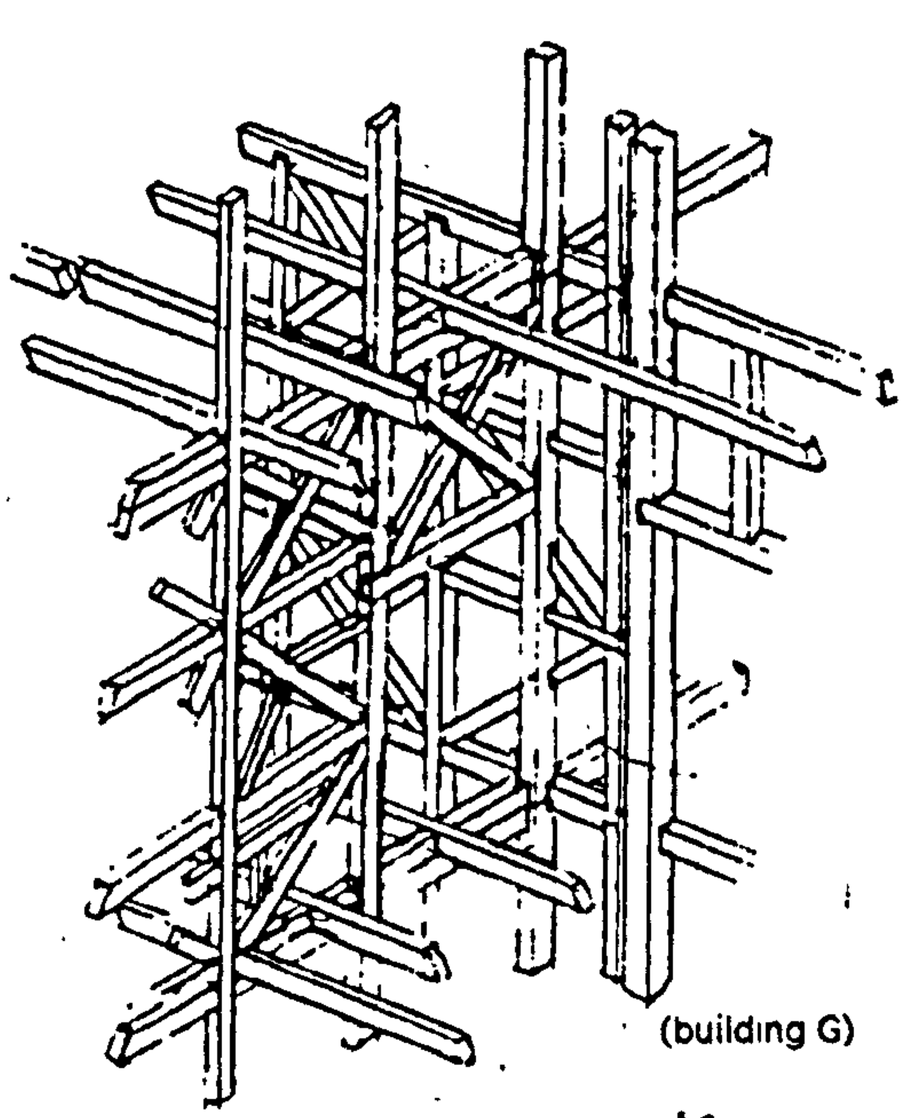


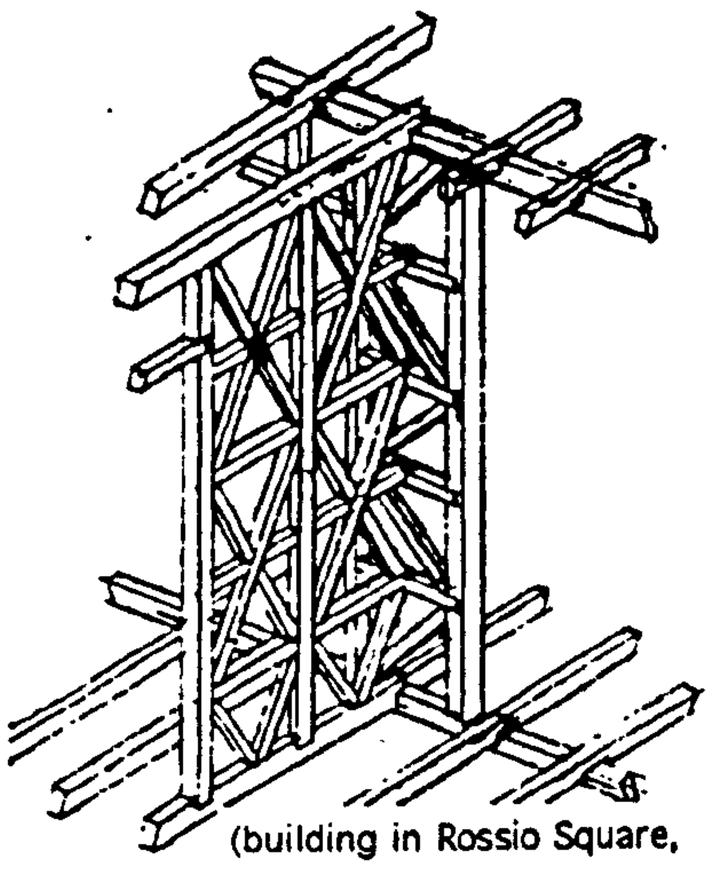
Fig.3.38-Tjunction, detail.



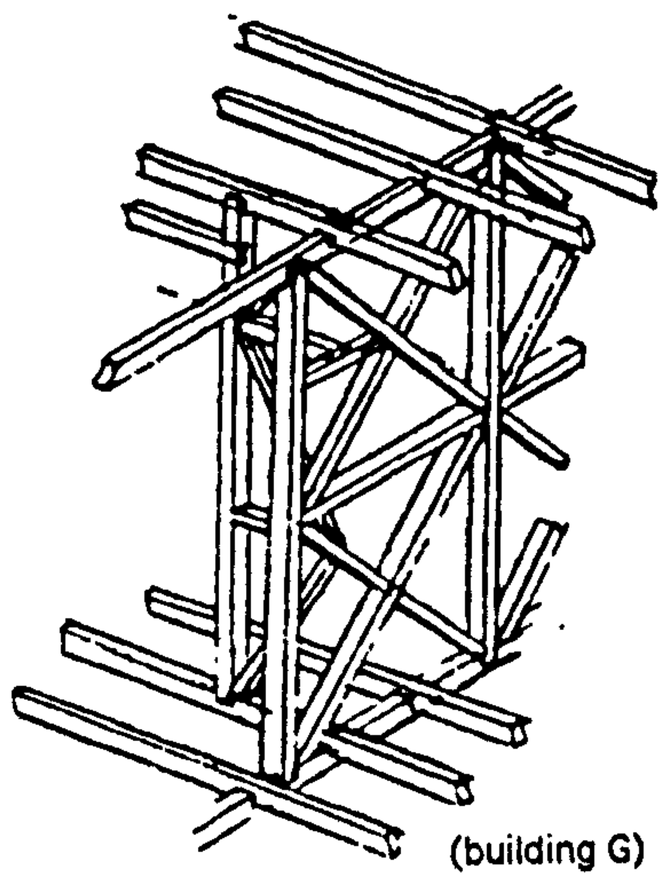
(building F)



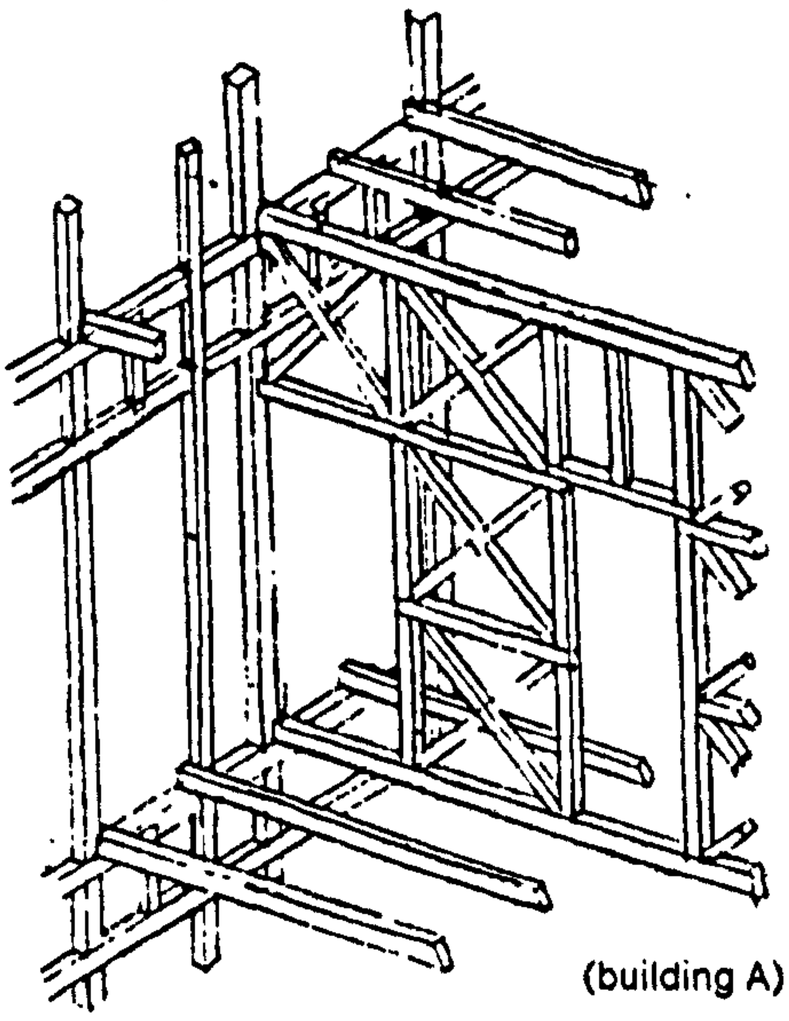
(building G)



(building in Rossio Square, "Pastelaria Suiça")



(building G)



(building A)

Fig.3.39-Examples of T junctions between panels

In all cases from the first floor upwards, all the walls in the building have the *gaiola* structure. However, the internal walls adjacent to the street and the internal courtyard were of a more simplified structure (Fig.3.40 and 3.41) than the other internal walls. In these walls the diagonal bracing disappeared leaving a few vertical and horizontal elements to which were fixed the wrought iron cramps which held in place the masonry around the door and window openings.

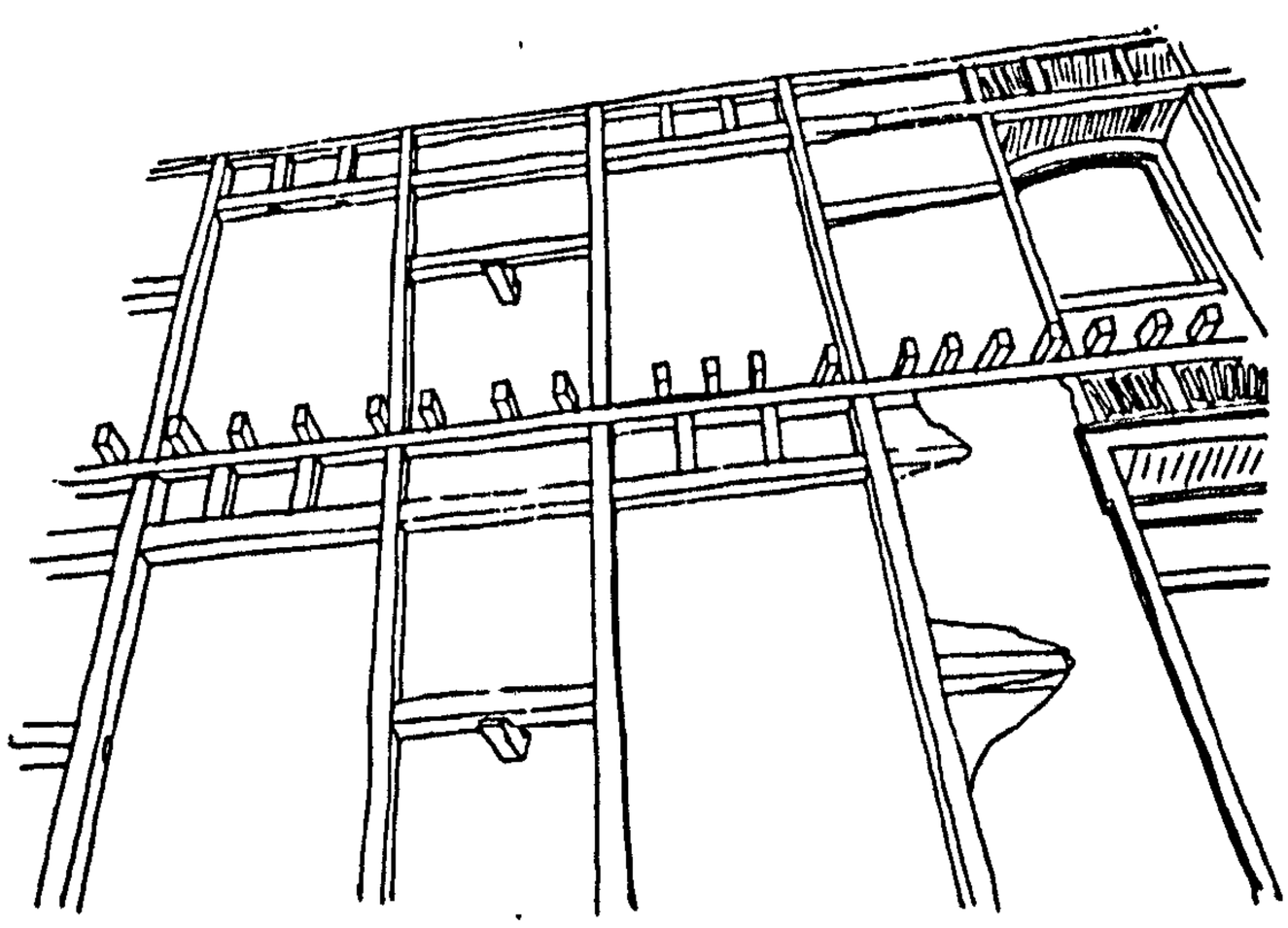


Fig.3.40-The structure on the façade walls

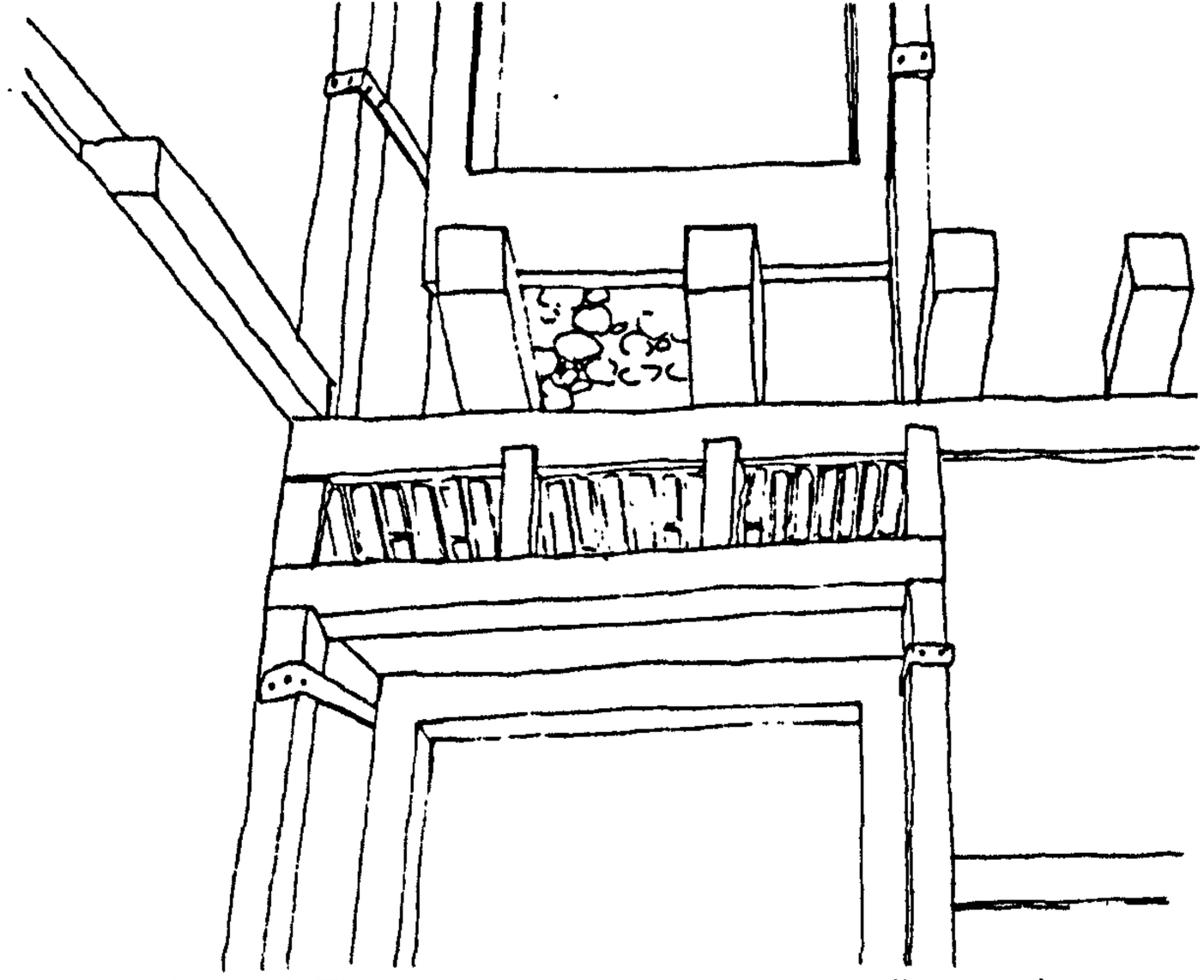


Fig.3.41-The structure on the façade walls, detail

The *gaiola* also had to support the staircase. In the case of dogleg staircases, the half landings spanned between the stairwell walls at either end of the half-landings, and these stairwell walls were reinforced typically by more horizontal members dividing them into a larger number of panels (see Fig.3.18). The flights were supported on carriages which spanned between the half-landings; however additional support was provided by the apparently solid balustrades, which in fact have a timber structure similar to that of the *gaiola*, and are continuous throughout the height of the staircase, (building A) (Fig.3.42).

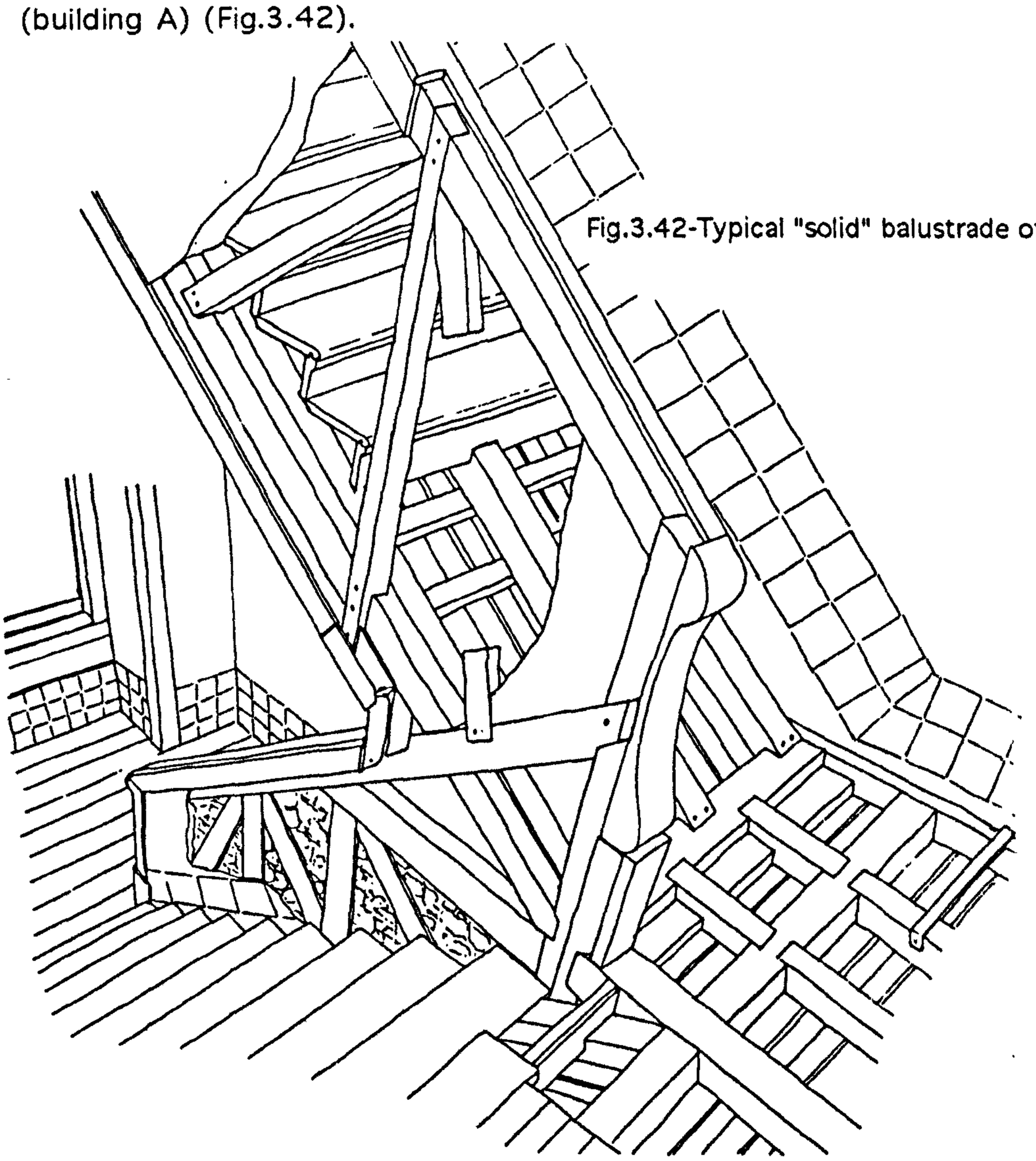


Fig.3.42-Typical "solid" balustrade of staircase

The wooden partition walls (*tabiques*) do not belong to the *gaiola* as they do not continue on the floor above or below. They were made in order to subdivide a space on a floor and are positioned in the *gaiola* structure by uprights inserted between two joists, to which diagonal struts were attached.

Planks called " costaneiras" were nailed (normally vertically rather than horizontally) onto the struts, then covered with laths and plastered, (buildings B, E and F) (Fig.3.43).

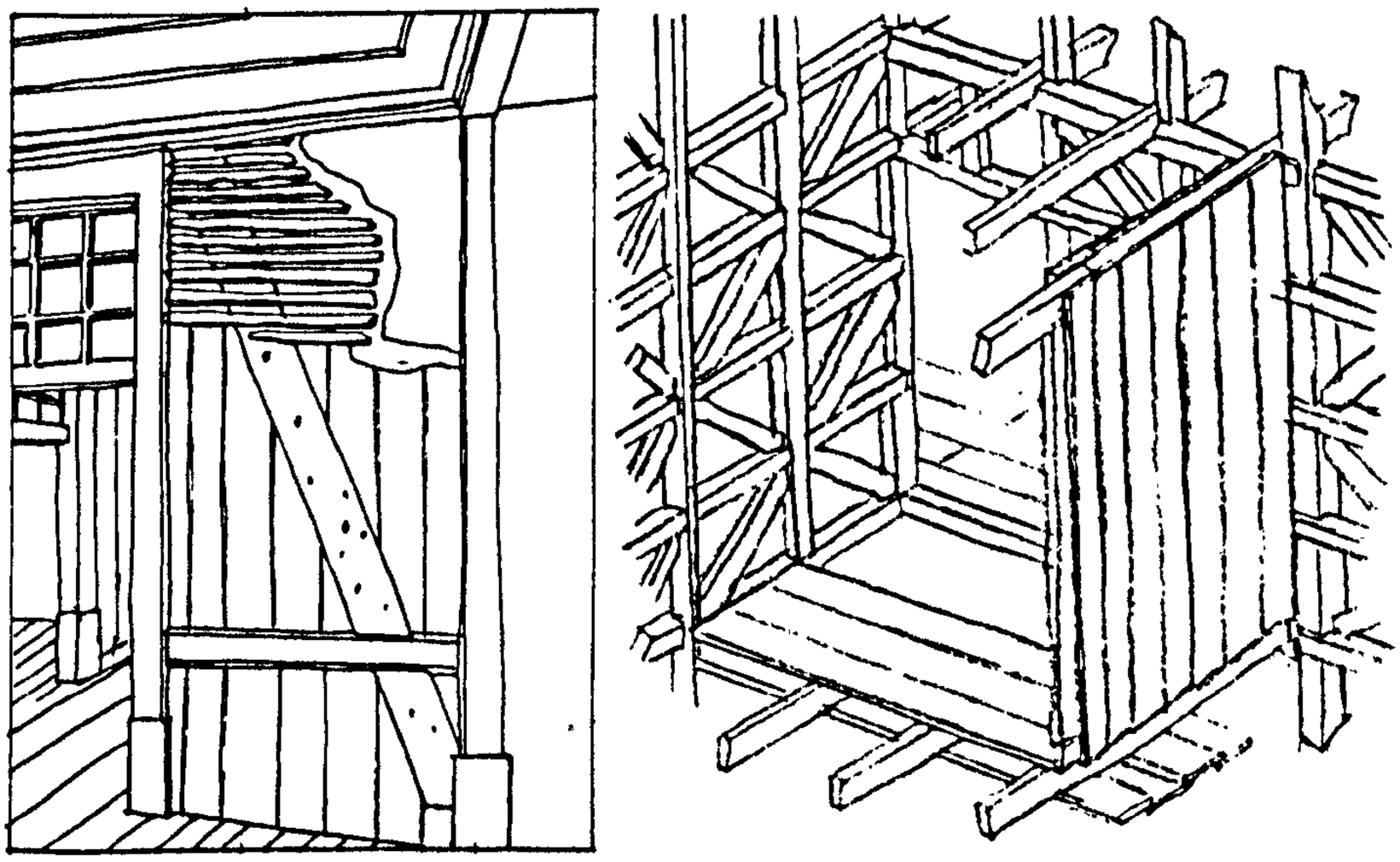


Fig.3.43-Example of a wood partition with "costaneiras"

3.4 The stairs.

For reasons of fire safety, in most buildings the steps of the first flight of stairs that give access to the residential floors were made of stone and above this the stair was made of wood, (Fig.3.44).

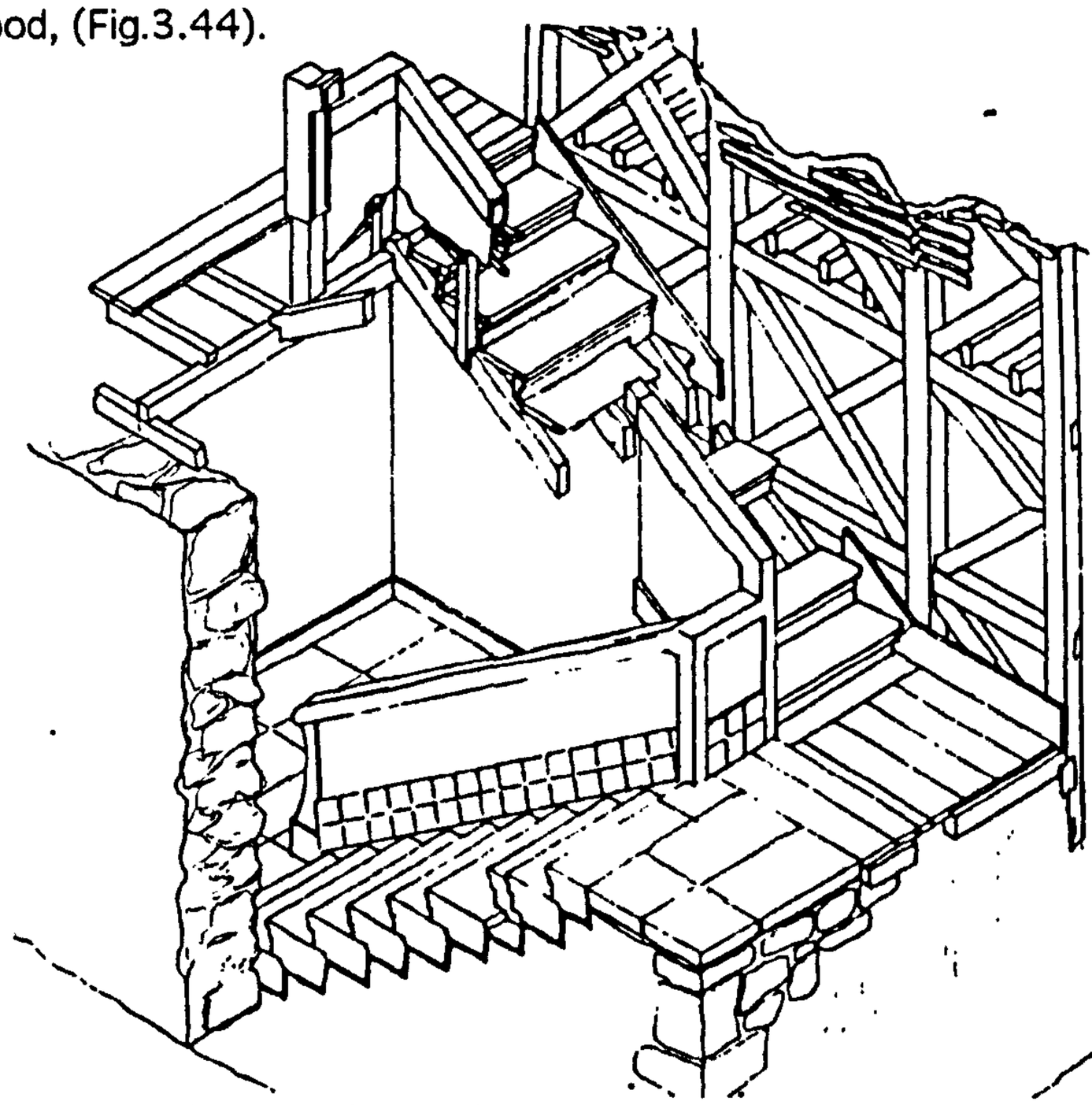


Fig.3.44-Cut-away isometric of ground floor staircase: construction detail.

From a construction point of view, the wooden stairs in the rentable building can be classified as follows:

i)Straight flight stair climbing alongside a wall which provides support, (Fig.3.45). This arrangement appeared in building types 1, 2B, 2C, 3 and 4. This form of stair had bearers which were placed laterally under the flights, transferring their weight onto timber walls, (Fig.3.46).

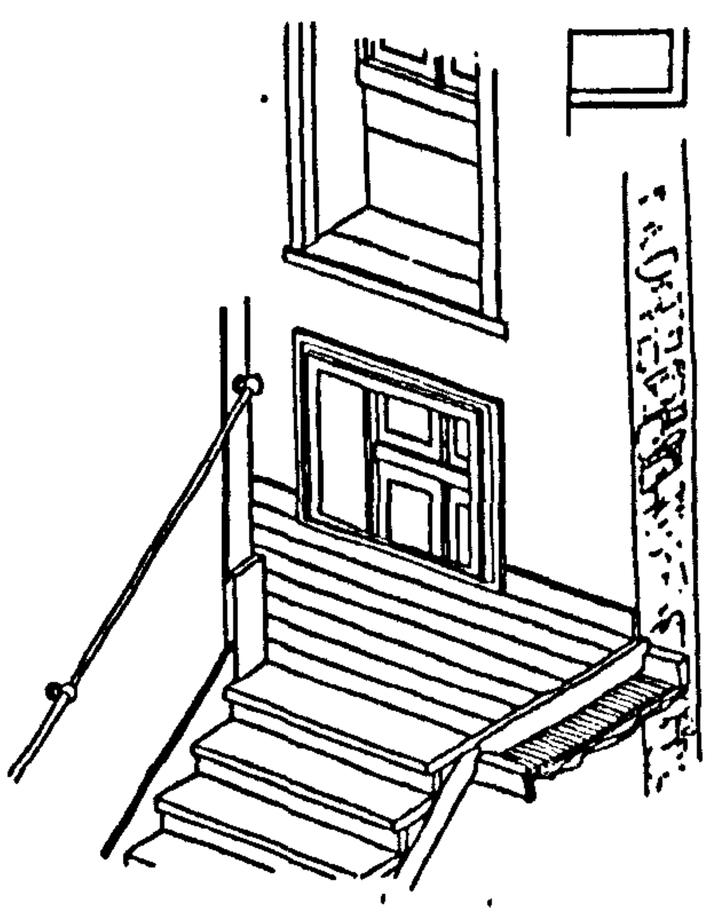


Fig.3.45-Stair climbing alongside walls

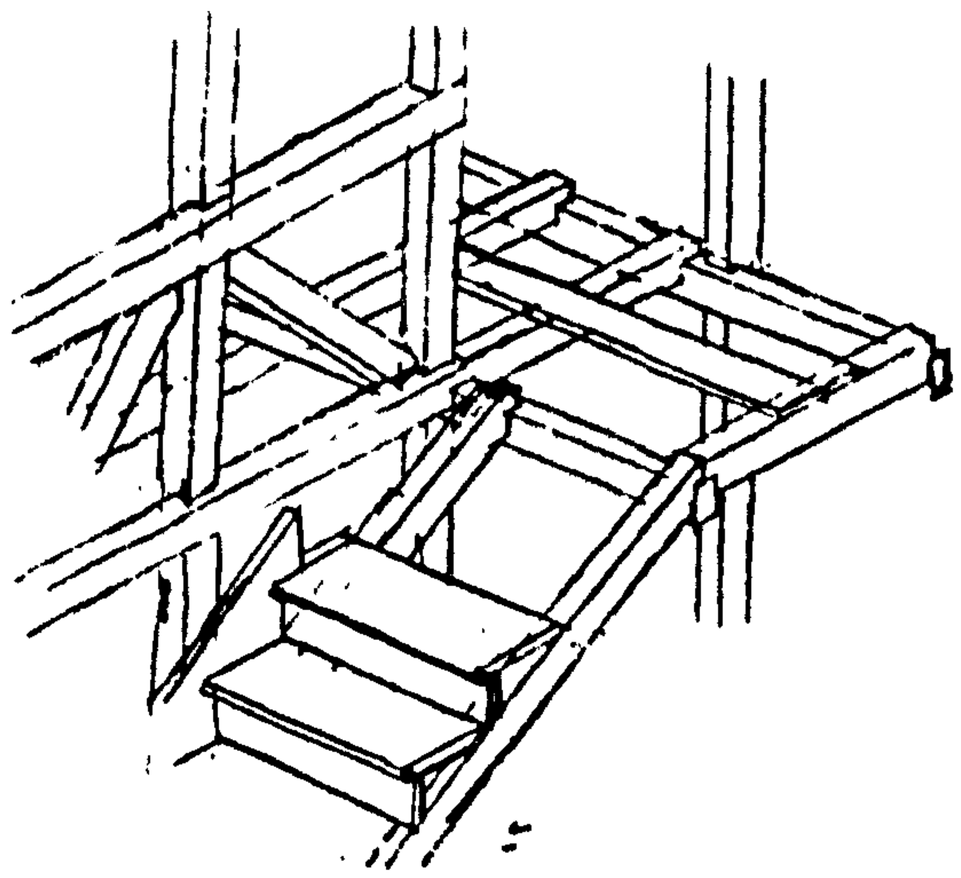


Fig.3.46-Construction detail of stair

ii)A dogleg stair with a central "solid" balustrade, which partially supported the flights and incorporated a cage; this arrangement is present for building types 5 to 7, (Fig.3.47 and 3.48).

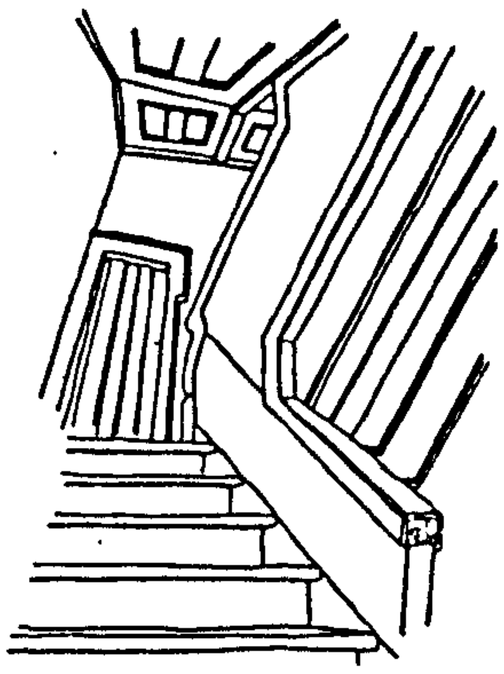


Fig.3.47-Dogleg staircase with "solid" balustrade

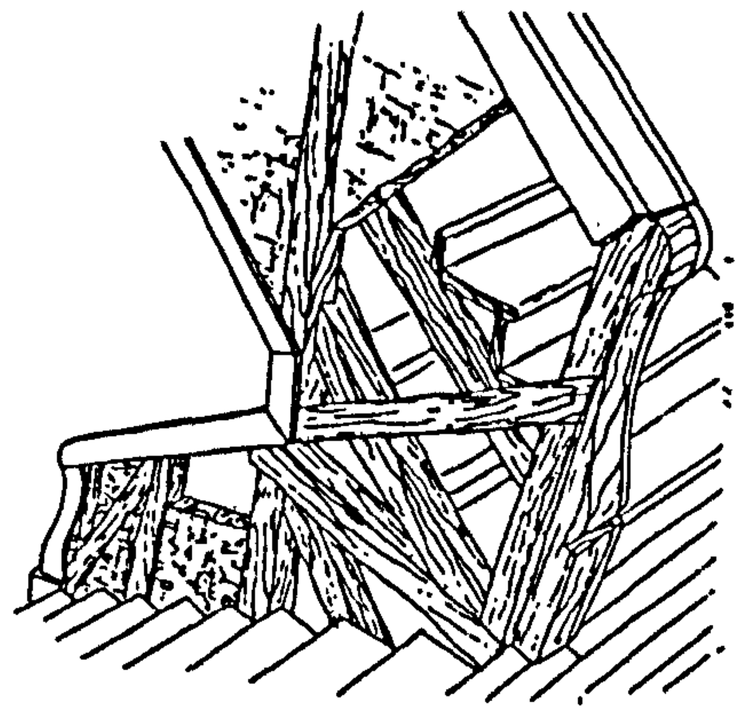


Fig.3.48-Construction detail of "solid" balustrade (building M)

iii)Stairs with an open newel to allow natural light. The flights were basically supported on two or three carriages with a cross-section of 0.14 x 0.08 m, inclined parallel to the flight, the ends being supported by the landing bearers, (Fig.3.49 and 3.50). This arrangement includes buildings types 8 to 10.

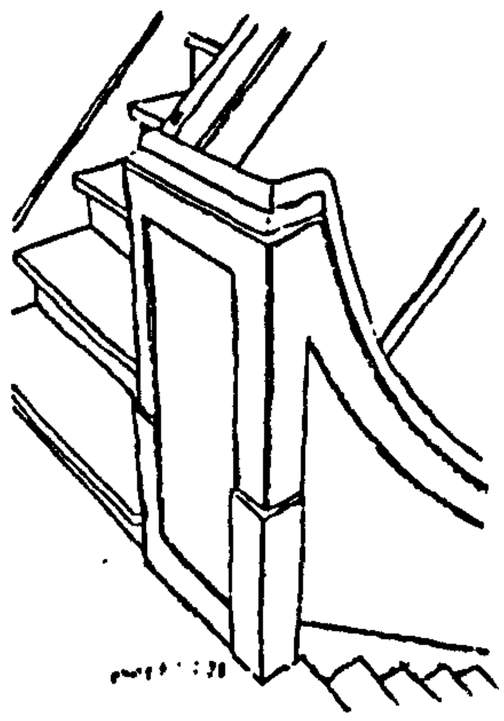


Fig.3.49-Stair climbing alongside an open newel

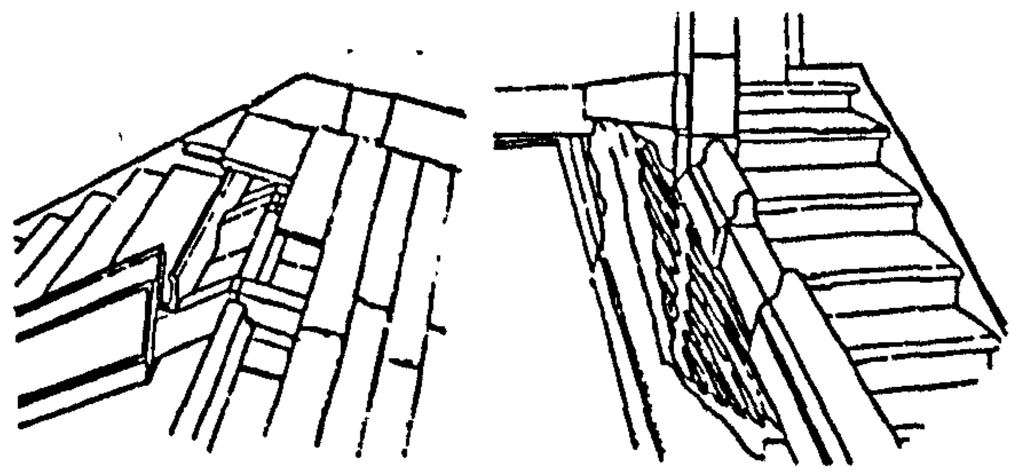


Fig.3.50-Construction detail of stair (building B)

iv)Stairs which were made with three different flights around the open newel. This arrangement includes only building type 11, (Fig.3.51 and 3.52).

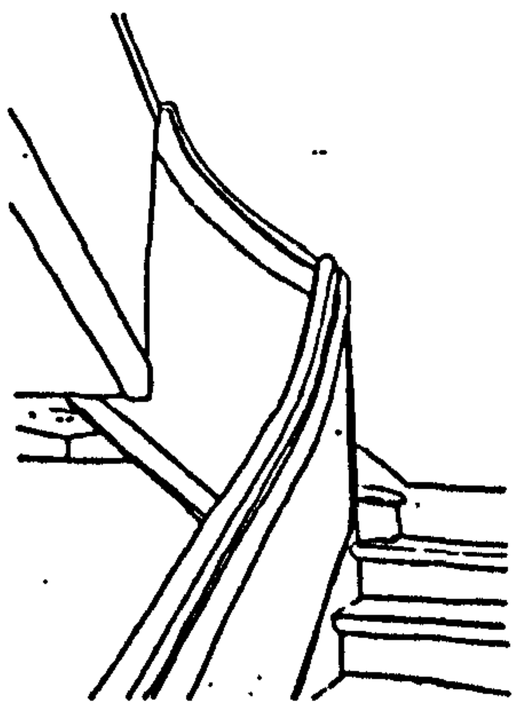


Fig.3.51-Stair with three flights

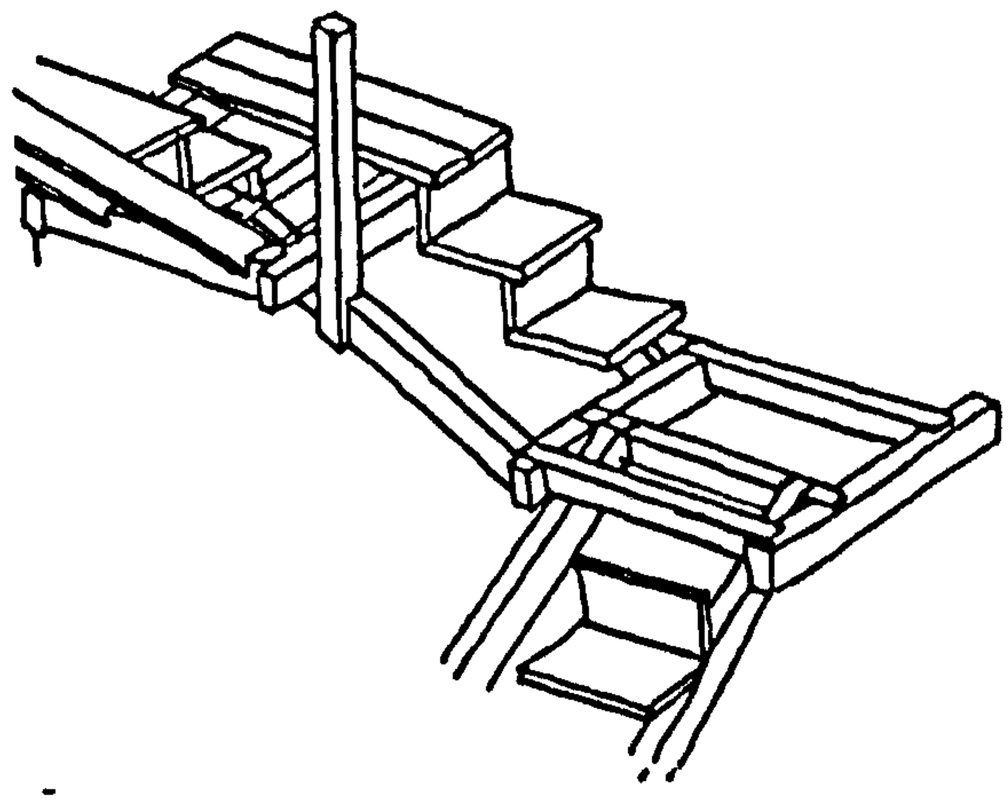


Fig.3.52-Construction detail of stair with three different flights (building L)

v) A helical stair, the most complex of all. This arrangement appeared only in buildings of type 12(building D)(Fig.3.53 and 3.54).

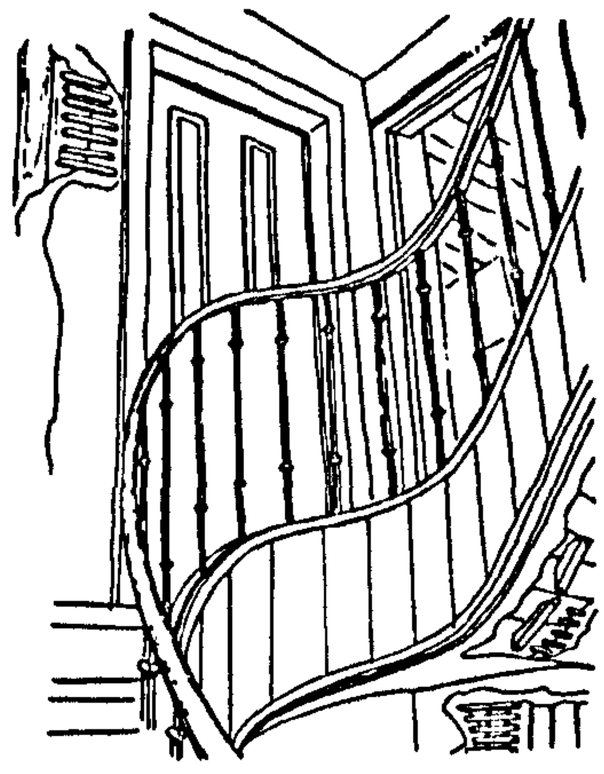


Fig.3.53-Helicoidal stair

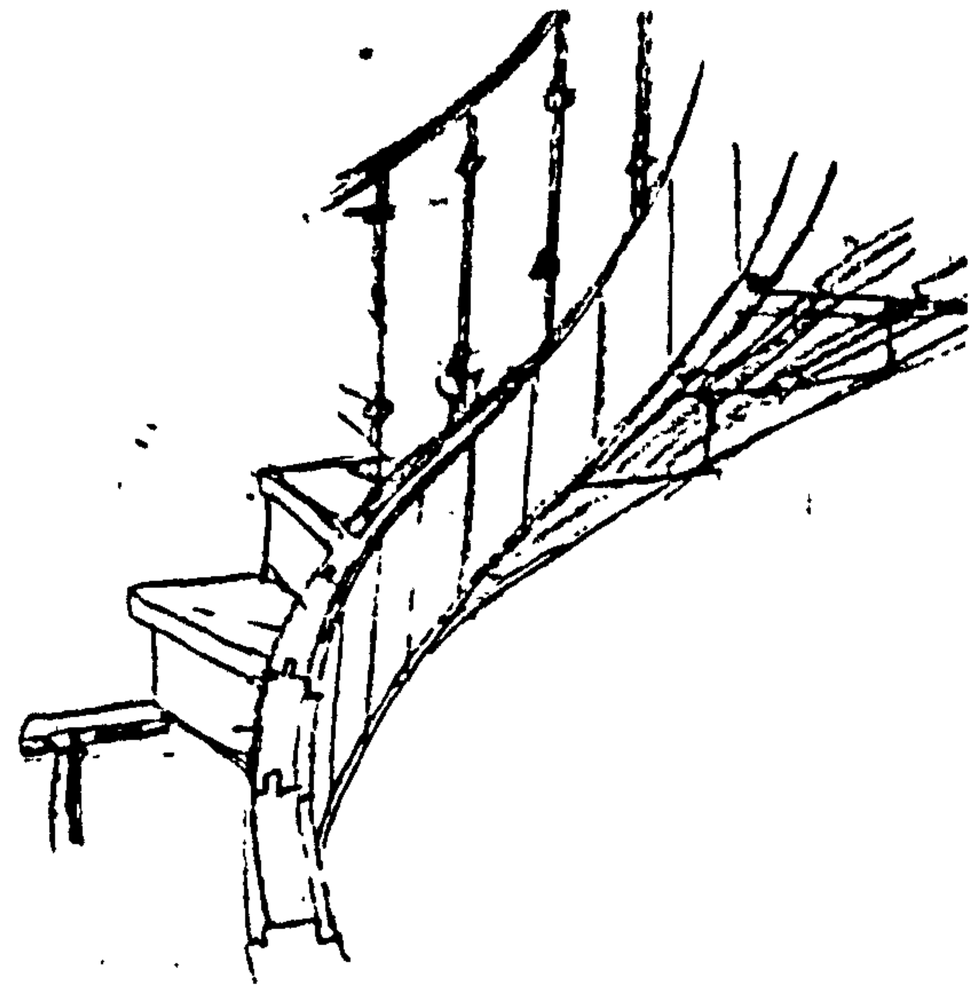
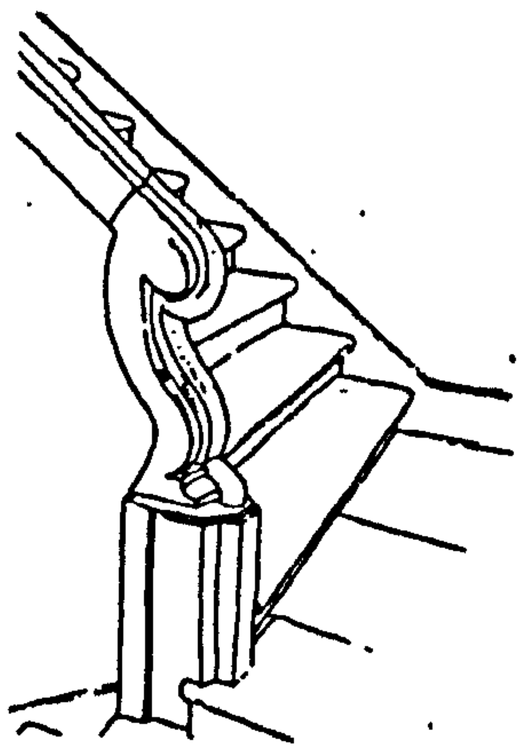
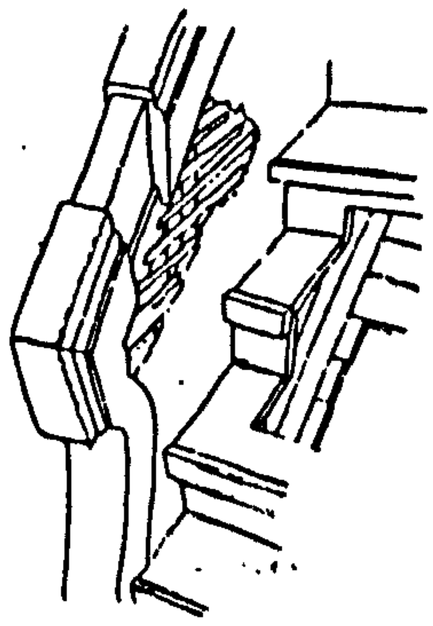


Fig.3.54-Construction detail of stair

In all forms of stair the treads usually rested upon the carriages. Both the treads and the risers were simple planks, 0.04m thick, which were rebated into one another; the edge of the tread was either rounded, (Fig.3.55) or had a separate nosing nailed to it, (Fig.3.56). In some cases the edges of the stairways were finished with a skirting board which was scribed to the treads and risers, (Fig.3.57).





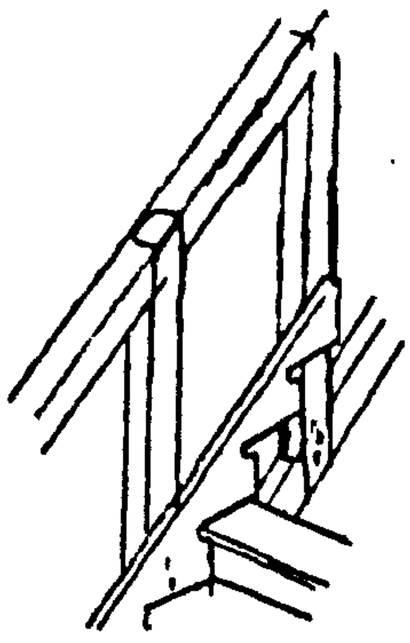


Fig.3.55-Round edge of the tread Fig.3.56-With a separate nosing Fig.3.57-With a skirting board

The staircases with open newels sometimes had solid balustrades, covered with lime or gypsum plaster (later), in the same way as the panels of the cage walls, finished off with carefully fitted moulded handrails and decorated with tiles (Fig.3.58). Others had iron balusters made up of modular sections that were easily made and simple to install as they were riveted to each other and were easily adapted to the required sizes and angles, (Fig.3.59).

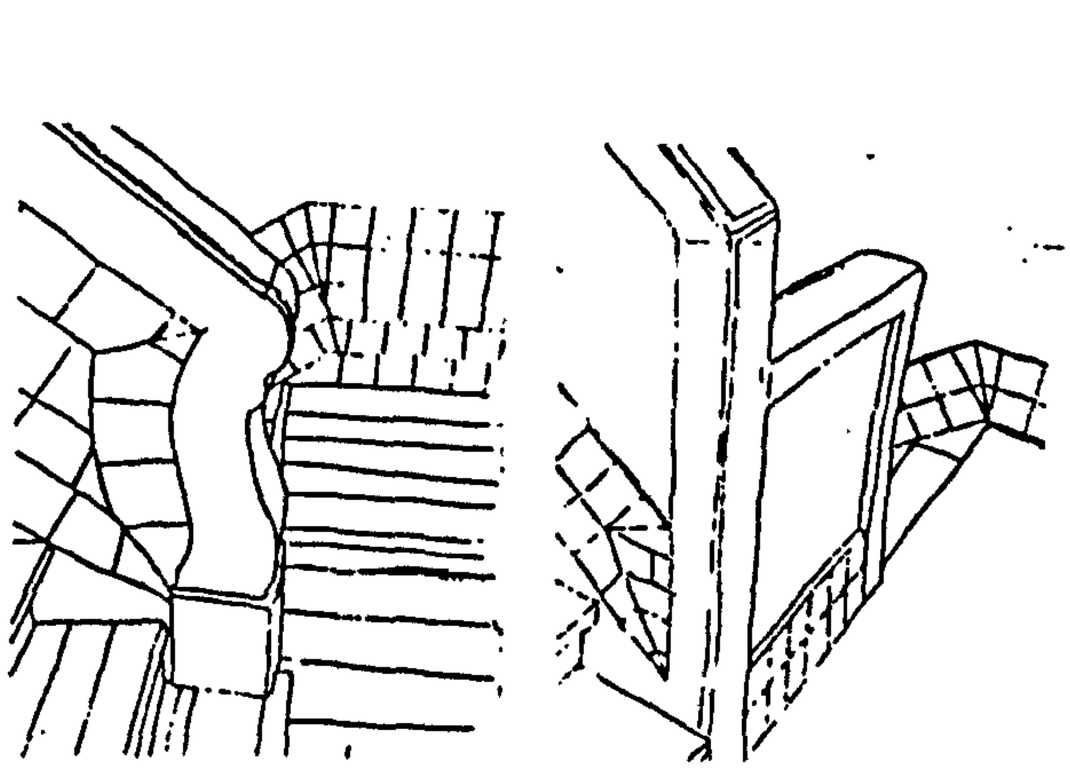


Fig.3.58-Stair with wall as balustrade

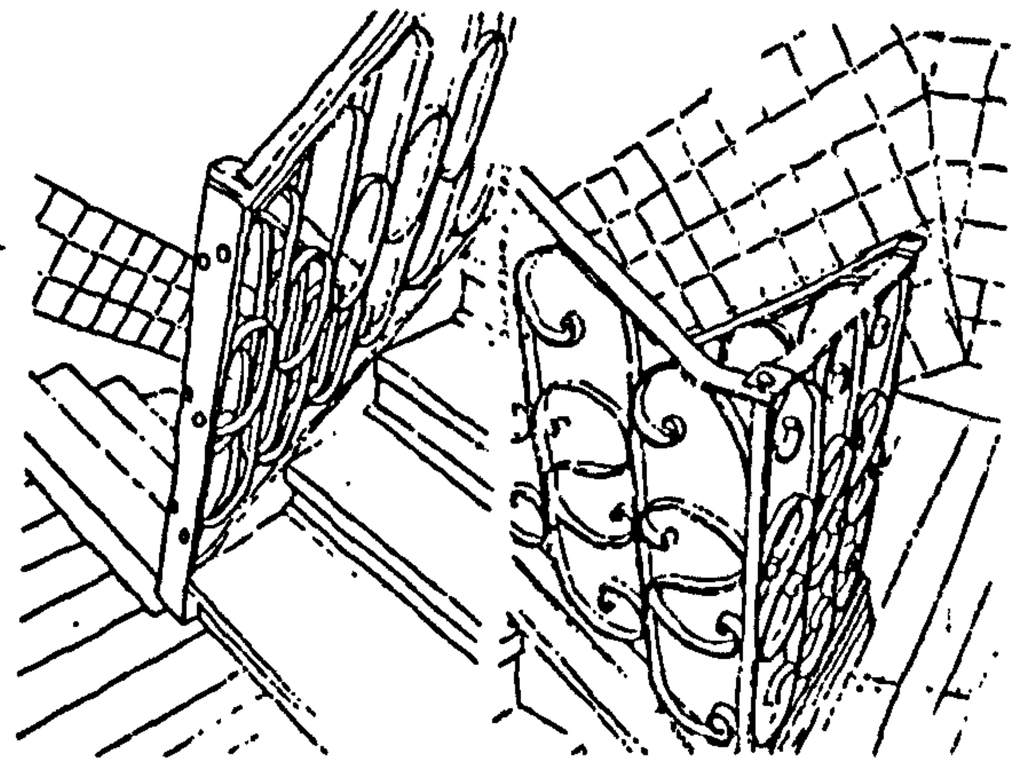


Fig.3.59-Stair with wrought iron balustrade

3.5 The façade

The solid parts of the façades are aligned both vertically and horizontally and in all buildings the wooden cage structure on the inside face of the external wall, (building P)(Fig.3.60 and 3.61) is without diagonal struts. In the event of an earthquake, it was probably not intended to support the stonework but merely to support the floor joists and to fix the masonry around the openings in order to prevent it from collapsing into the street, (Fig.3.62 and 3.63).

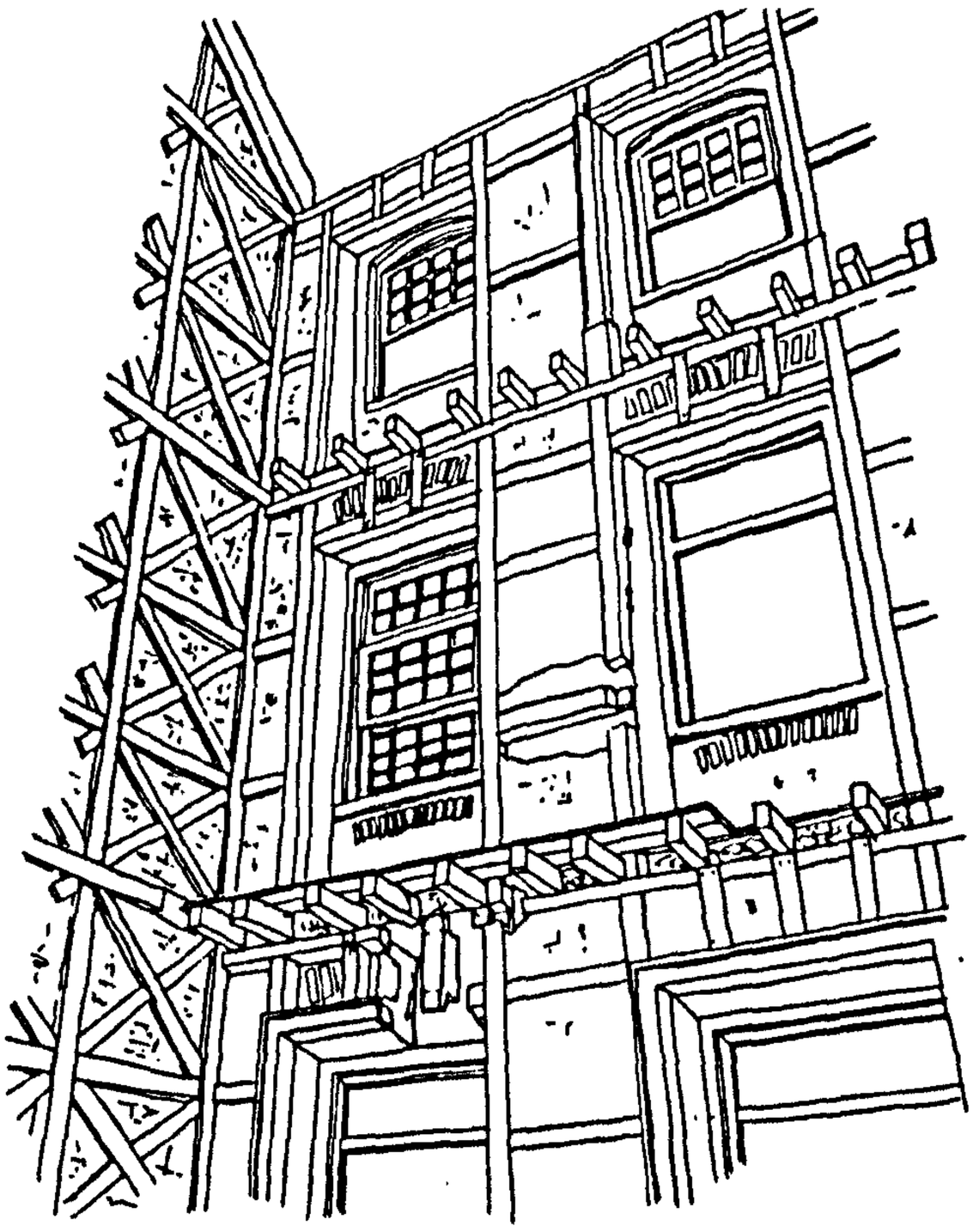


Fig.3.60-The wooden cage structure on the inside face of the external wall

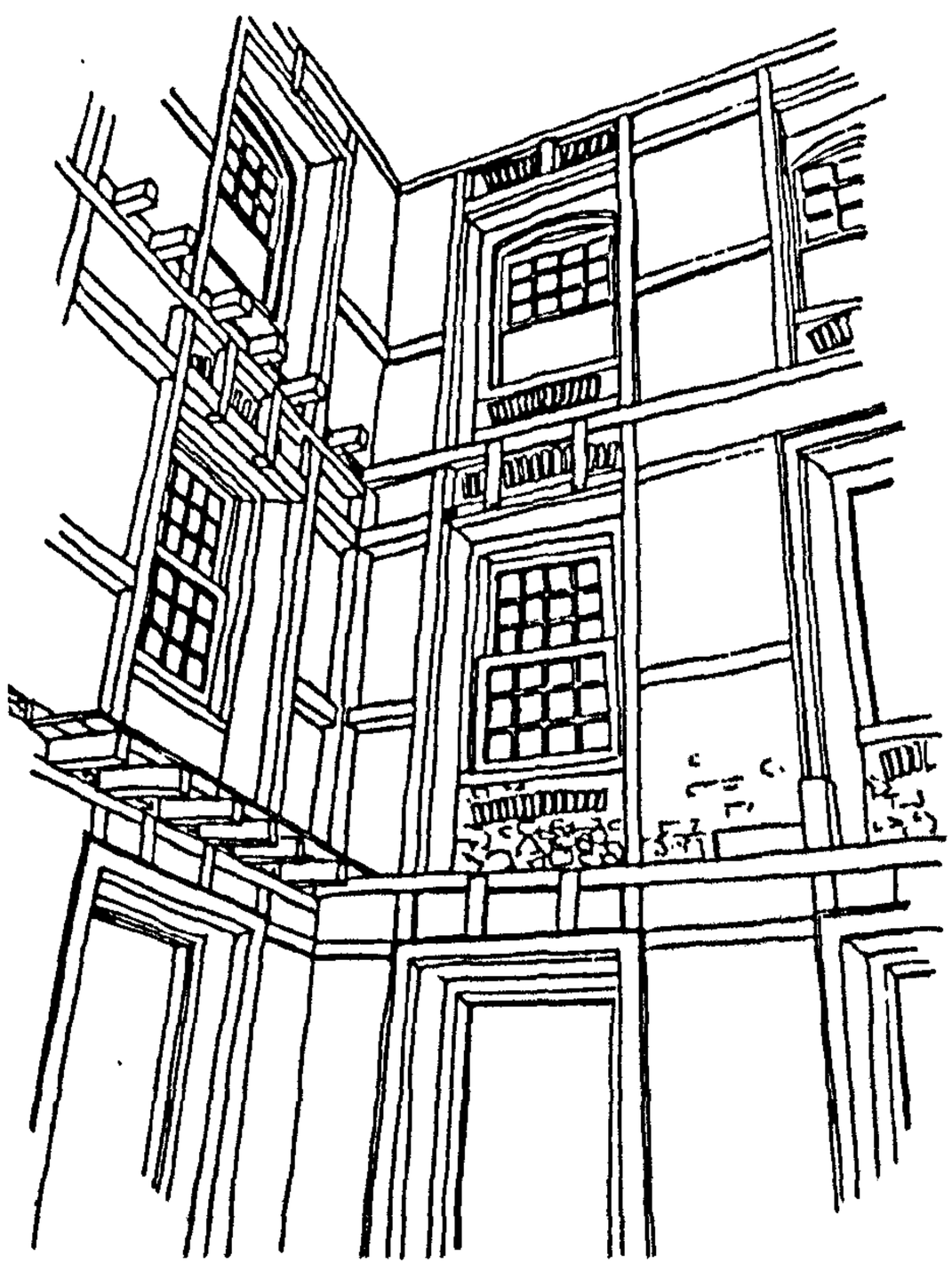


Fig.3.61-The wooden cage structure on the inside face of the external wall façade (corner).

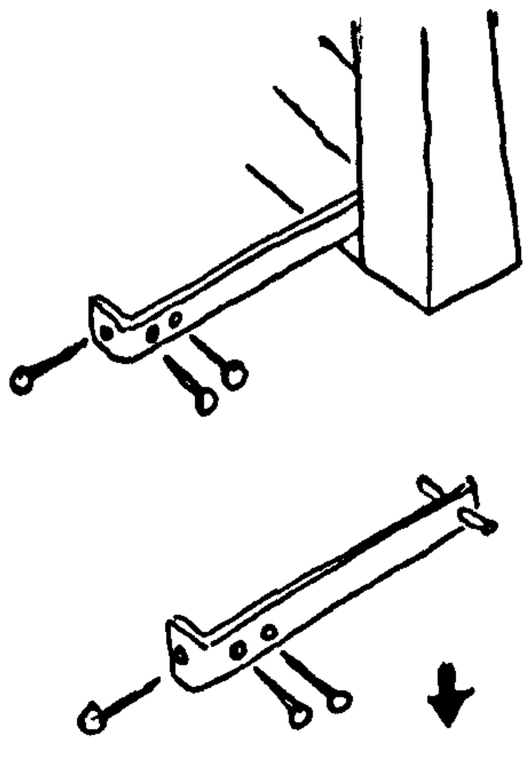


Fig.3.62-Fixing of stone window jambs to the *gaiola* (buildings I and P)

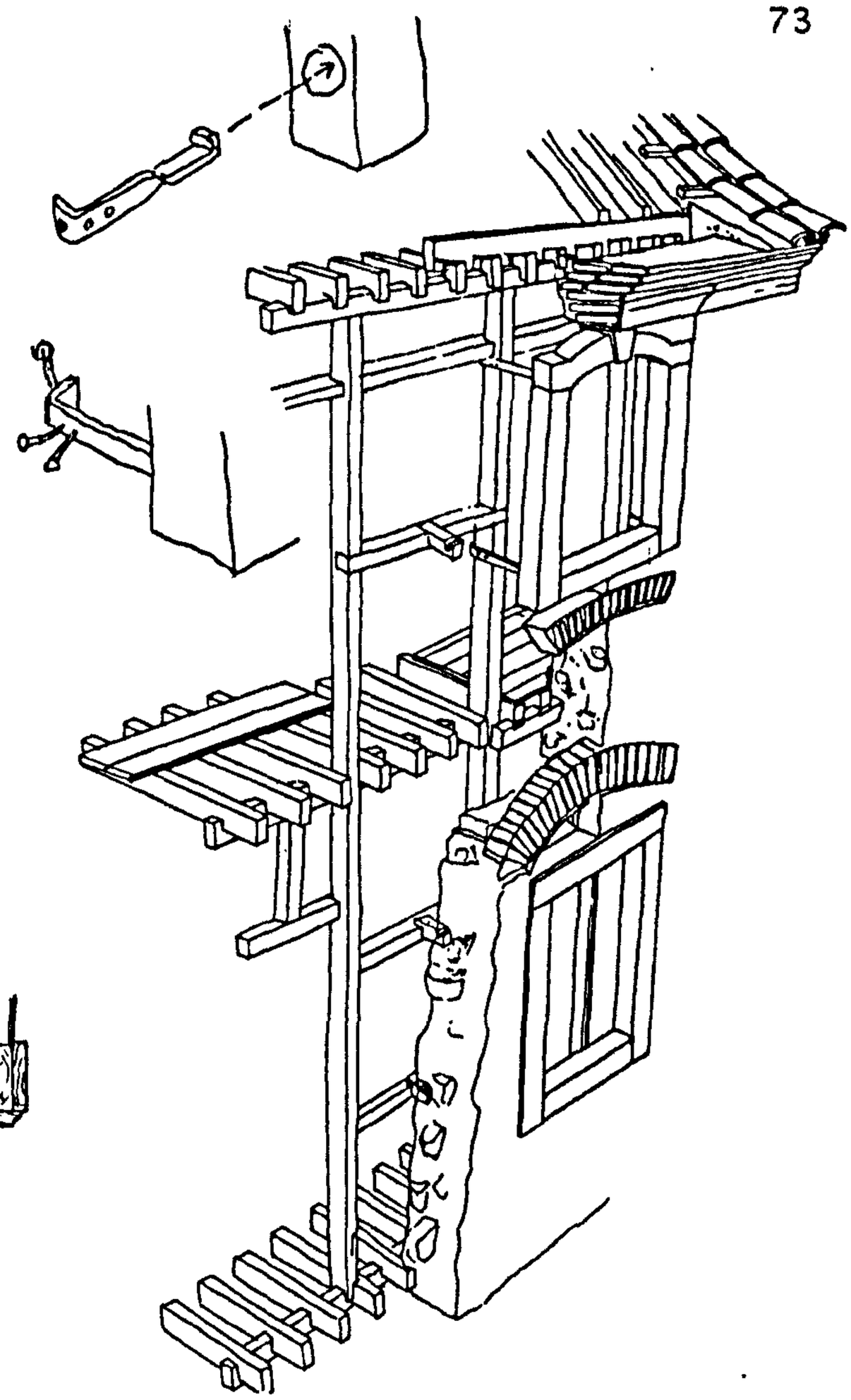


Fig.3.63-Fixing of stone window jambs and rubble stonework to the *gaiola* (buildings I and P)

The pilasters and their bases were faced with ashlar stone, 0,15m or less in thickness, and the various parts were fixed to the structural wall with iron cramps; the same system was used for the quoins, (building P)(Fig.3.64).

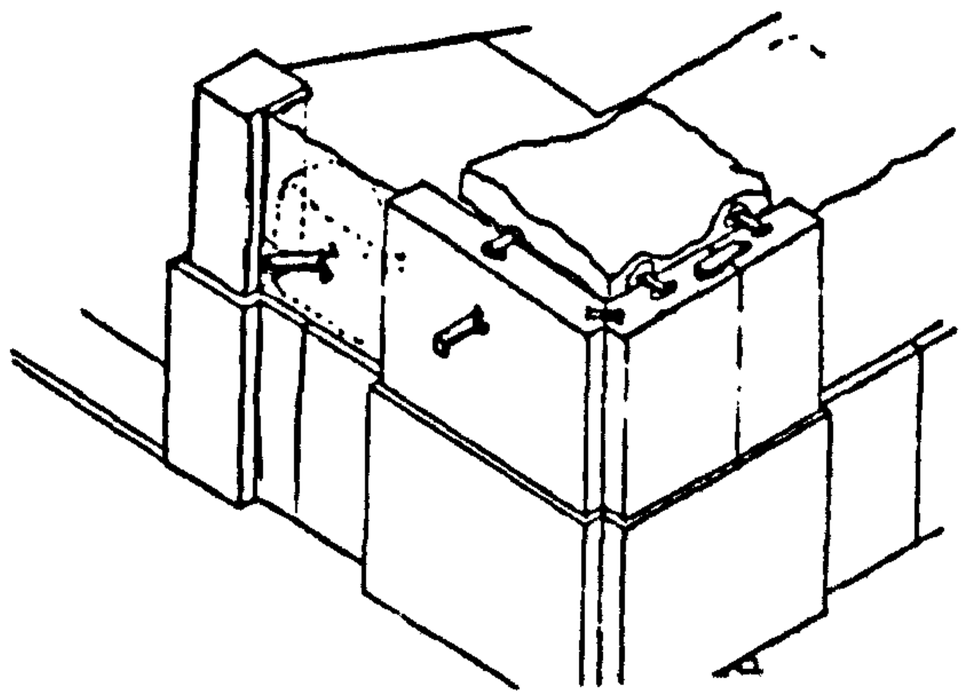
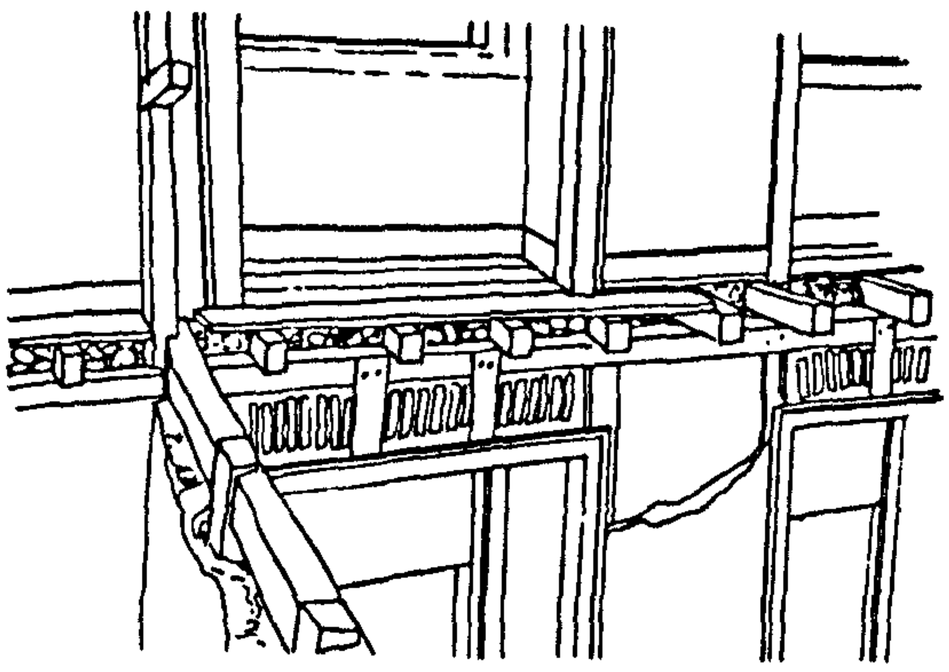


Fig.3.64- Fixing of ashlar quoins with iron cramps

The materials used in the construction of the façade varied. The rubble stonework which made up the main body of the façade, the bases, keystones, friezes, lintels, doorposts, parapets and window sills were all in stone. However, the cornices, the walls beneath the sash windows and the relieving arches were all in brick, (Fig.3.65, 3.66, 3.67 and 3.68).



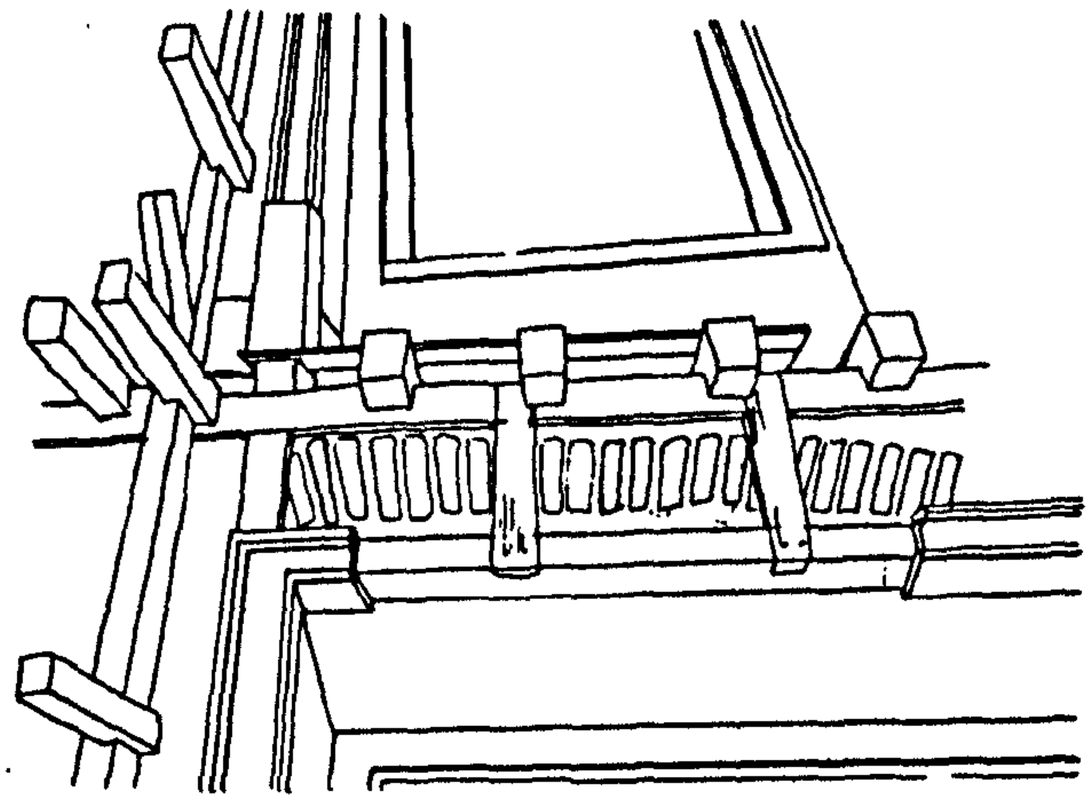


Fig.3.65-Connections of the interior panels to the façade gaiola (buildings D and E)

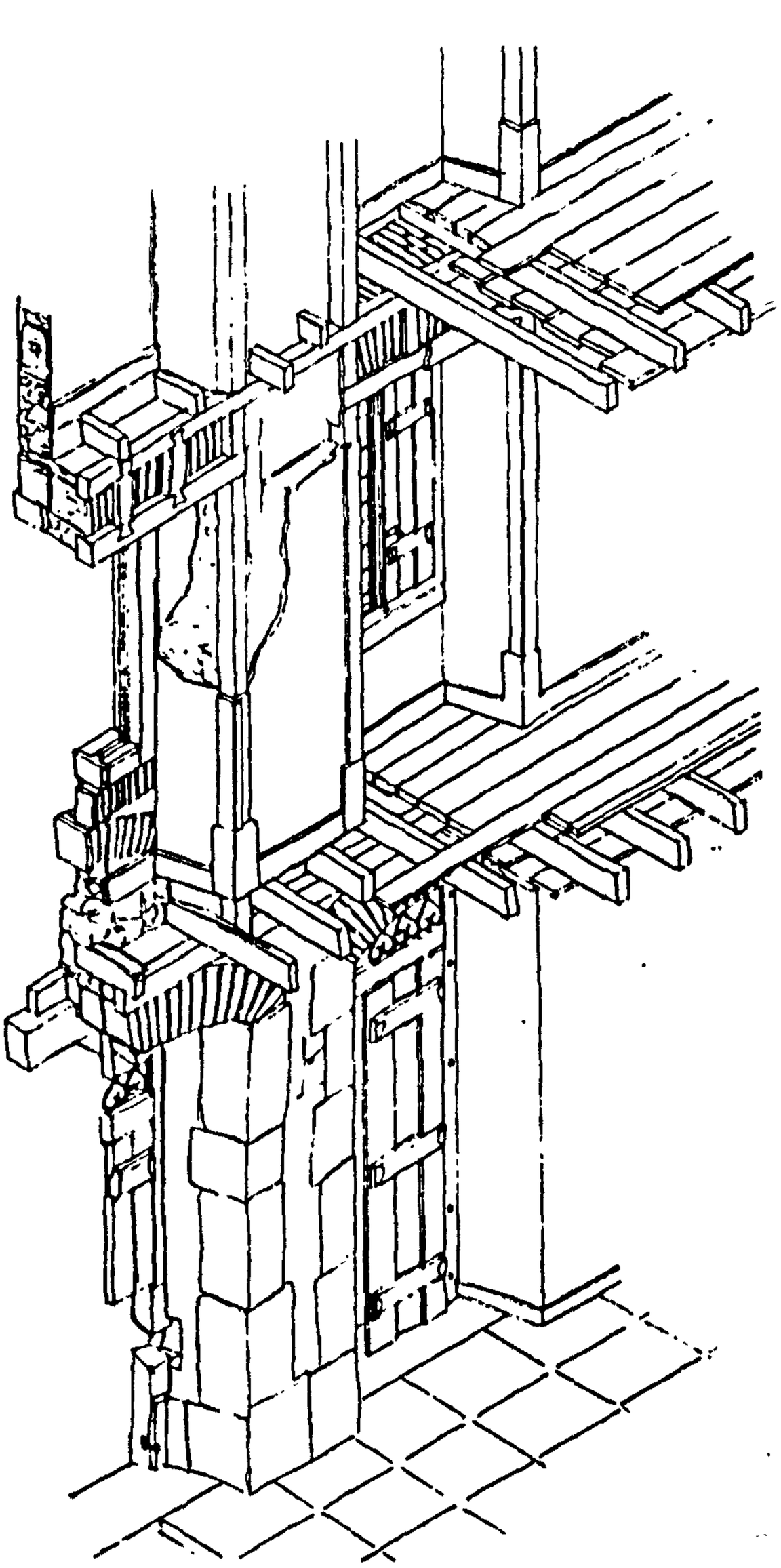


Fig.3.66-Façade construction details viewed from inside (building P).

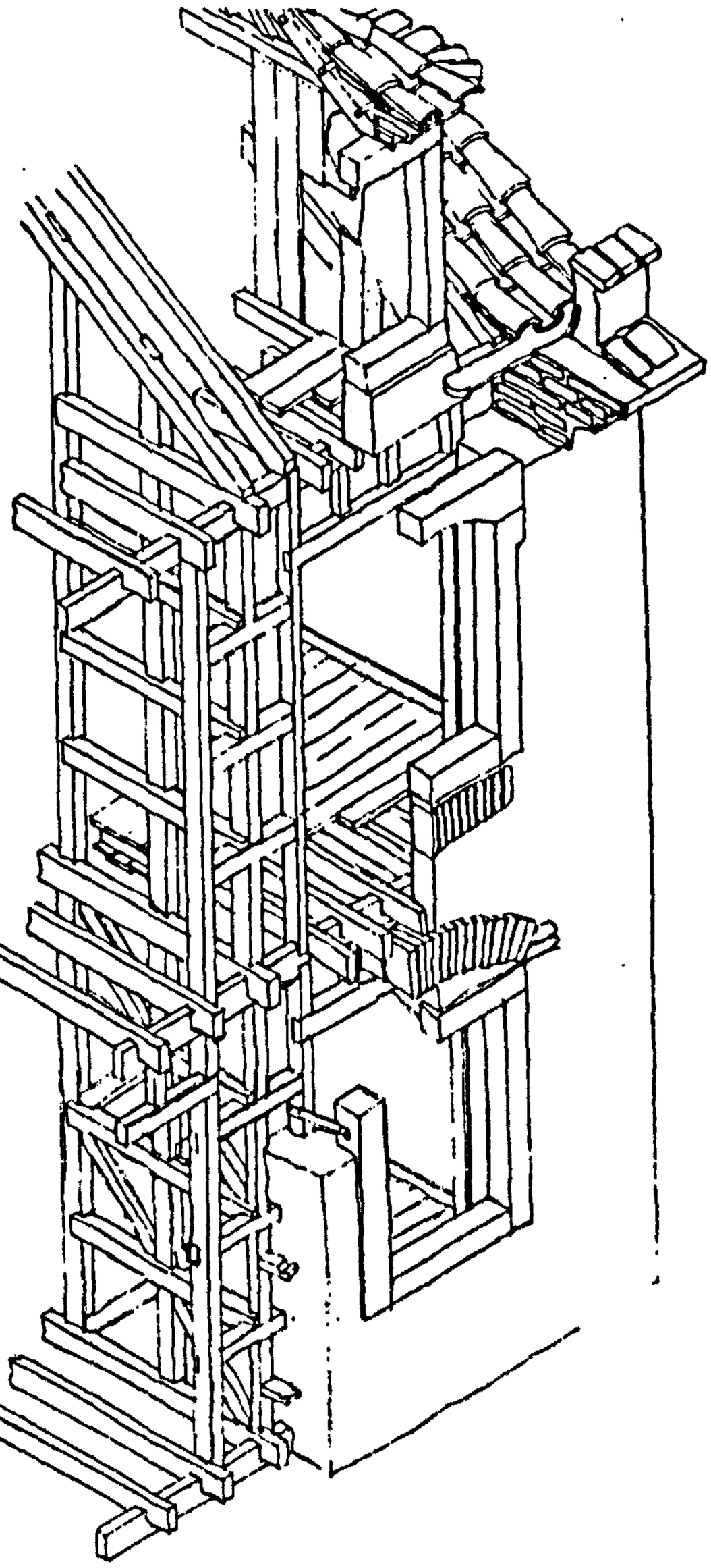


Fig.3.67-Façade construction details viewed from outside (building P).

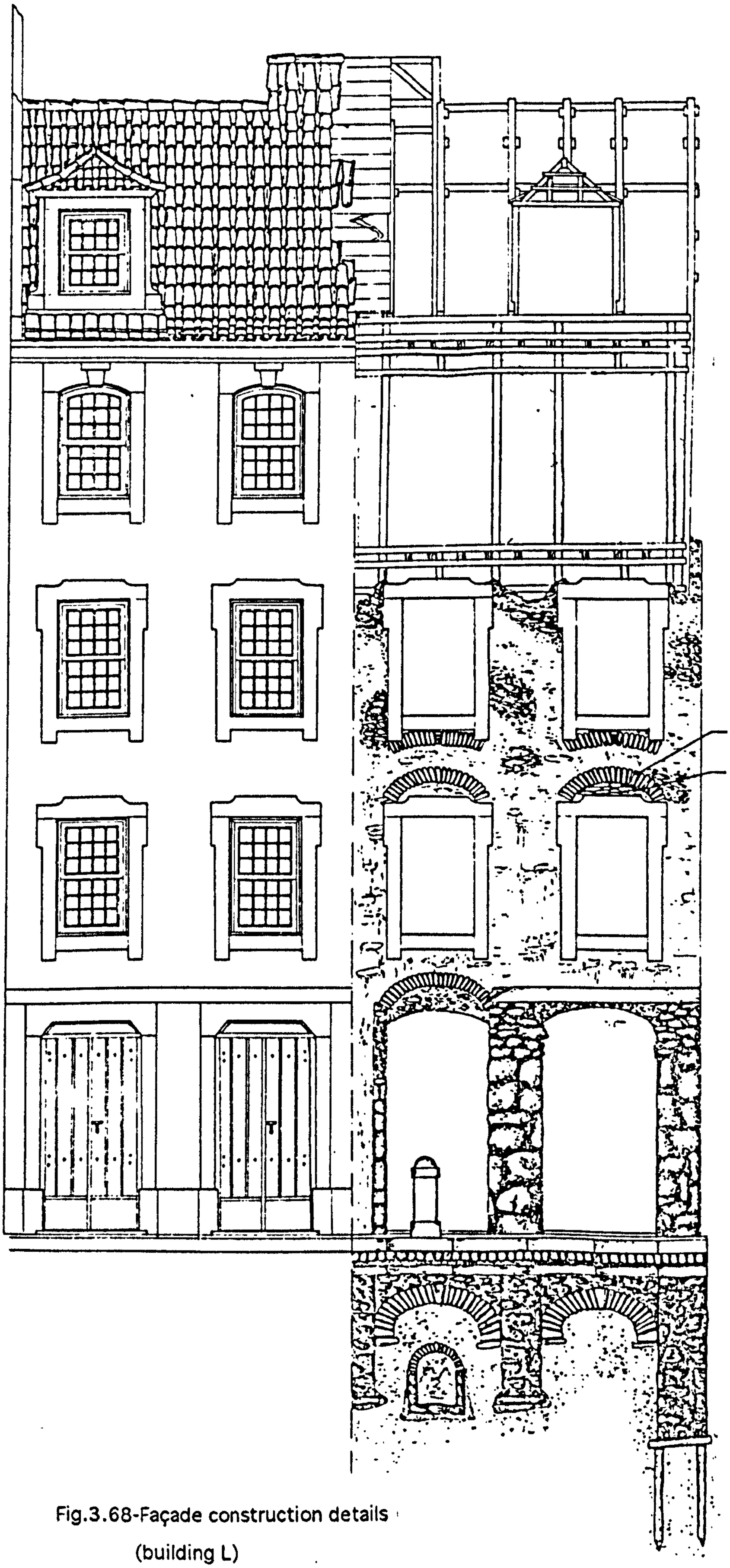


Fig.3.68-Façade construction details

(building L)

3.6 The roof.

The Pombaline rentable buildings are covered by mansard or dual-pitched roofs, with the party walls rising 0.80 m above the roof to prevent fire spread.

The buildings situated on corners have hipped roofs with valleys at the junction of the inside roof slopes.

The buildings situated in squares and main streets have mansard roofs. These had a more complex structure, allowing for a reasonable ceiling height throughout the attic as well as easy access to the windows, (Fig.3.69 and 3.70).

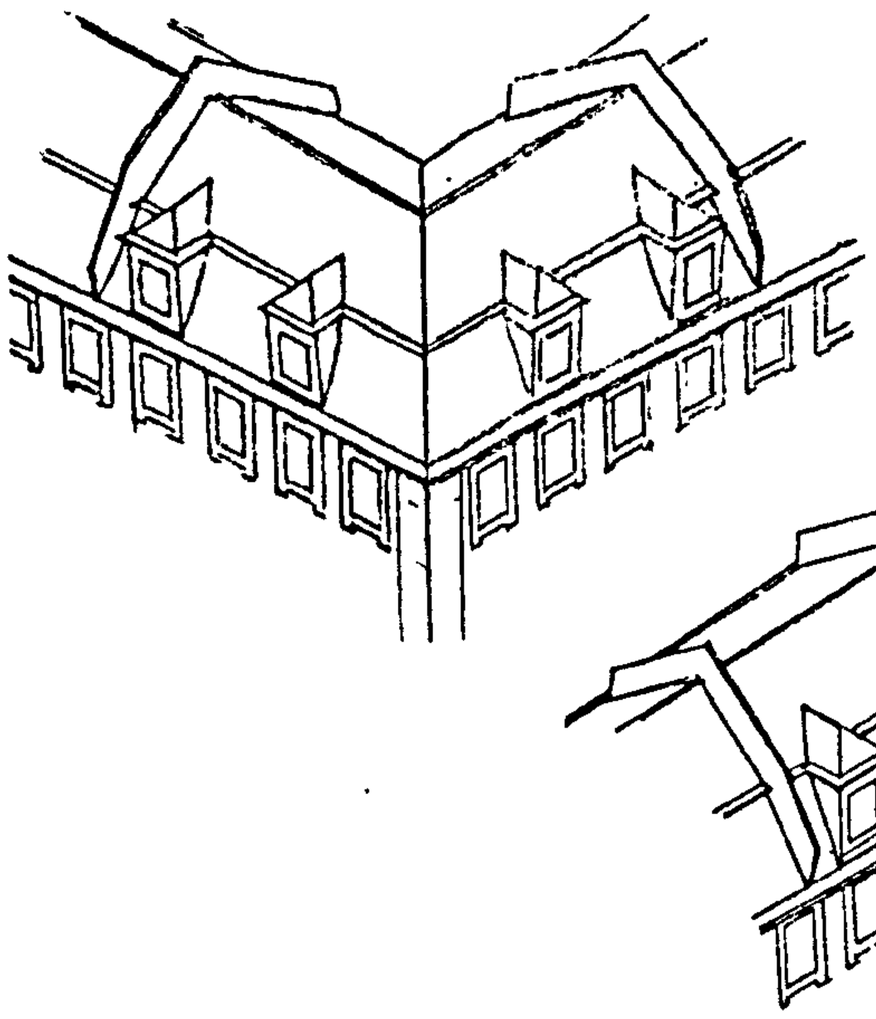


Fig.3.69-Mansard roofs
intermediate and corner examples

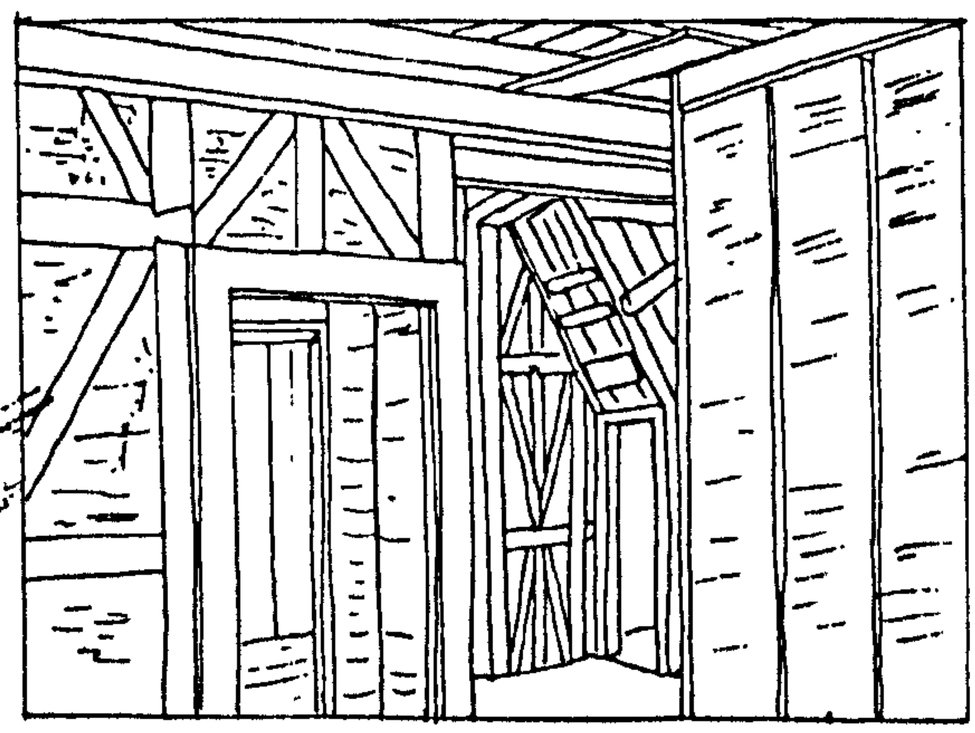


Fig.3.70-View from the interior
(building E)

Dual-pitched roofs covered most buildings. These were simple in construction and close to the traditional style. The habitable space in the roof was reduced and access to the windows was via a long narrow, bay projecting into the dormer, (Fig.3.71 and 3.72).

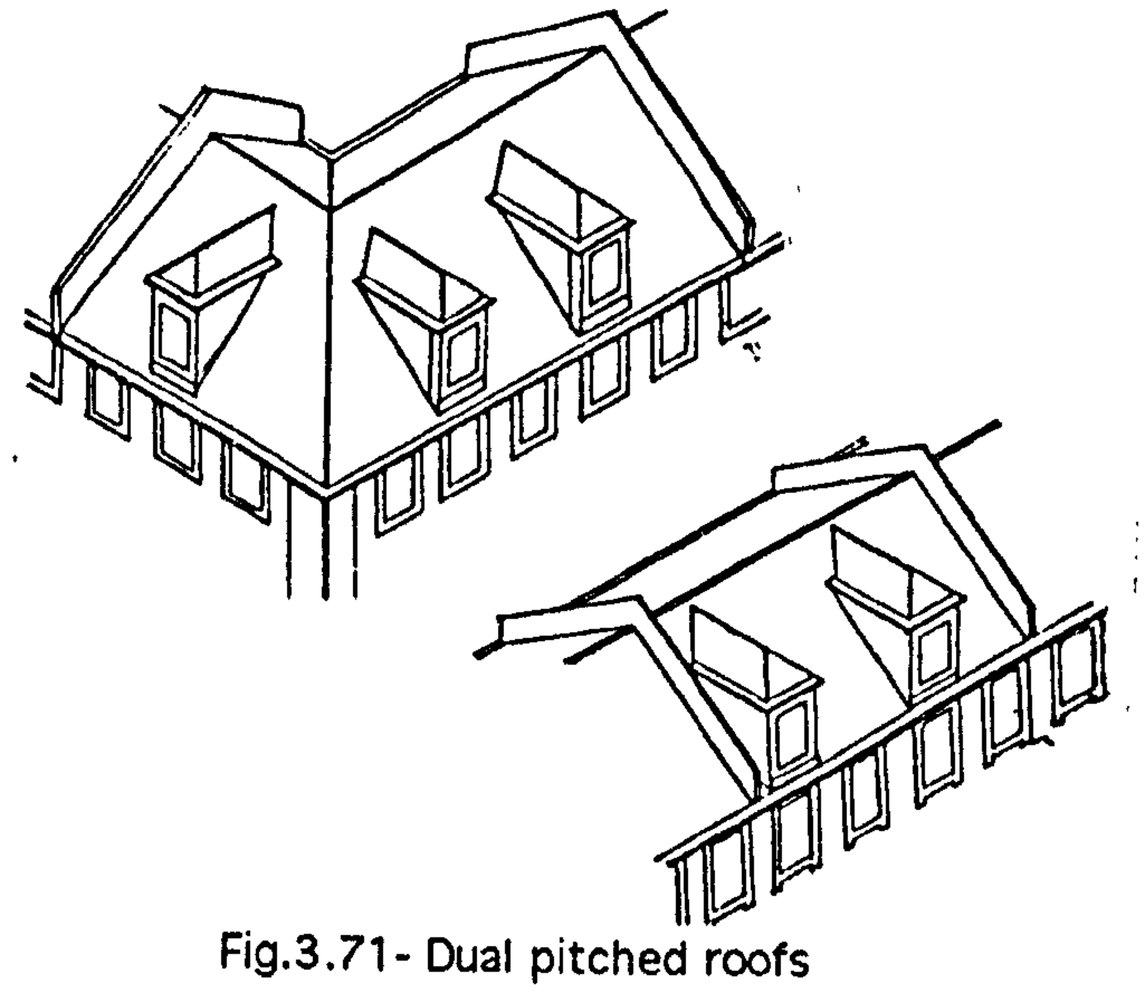


Fig.3.71- Dual pitched roofs
intermediate and corner examples

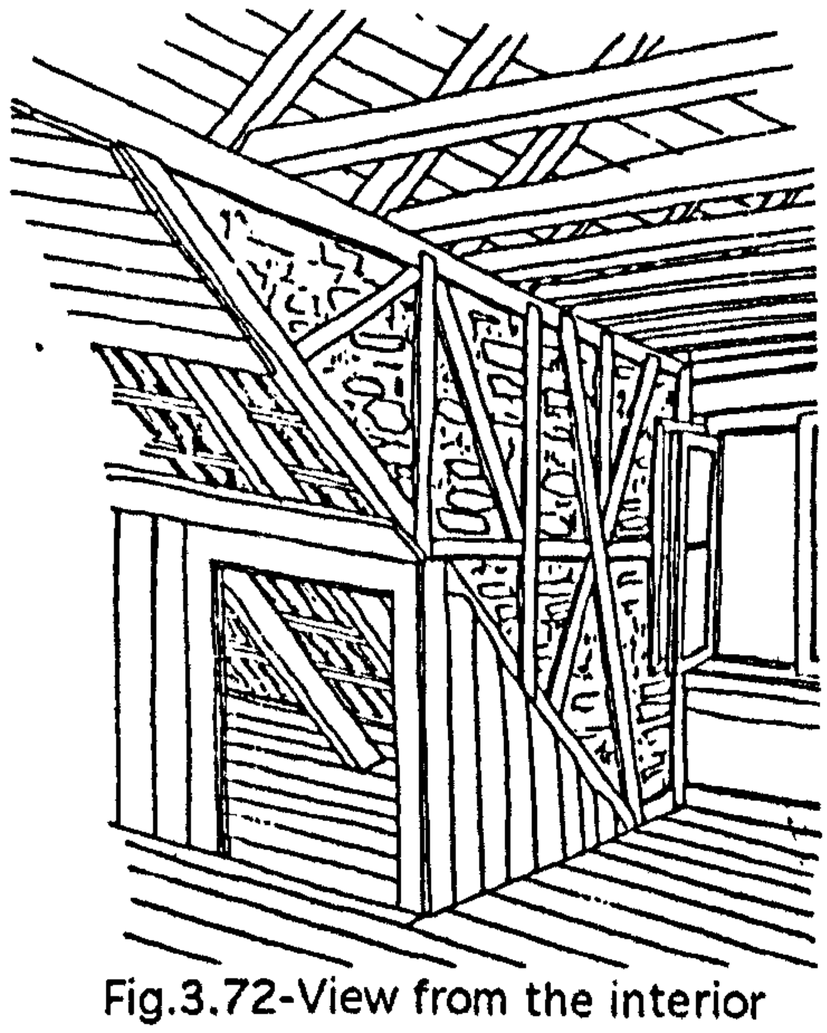


Fig.3.72-View from the interior
(building C)

In both types, the roof structure was connected to the structure of the cage. In some cases trusses act as supports to the heavy load of the roof, (Fig.3.73, 3.74, 3.75, 3.76 and 3.77). This was necessary because in most cases the wood used was of poor quality, and the spans are excessive for normal-sized common rafters.

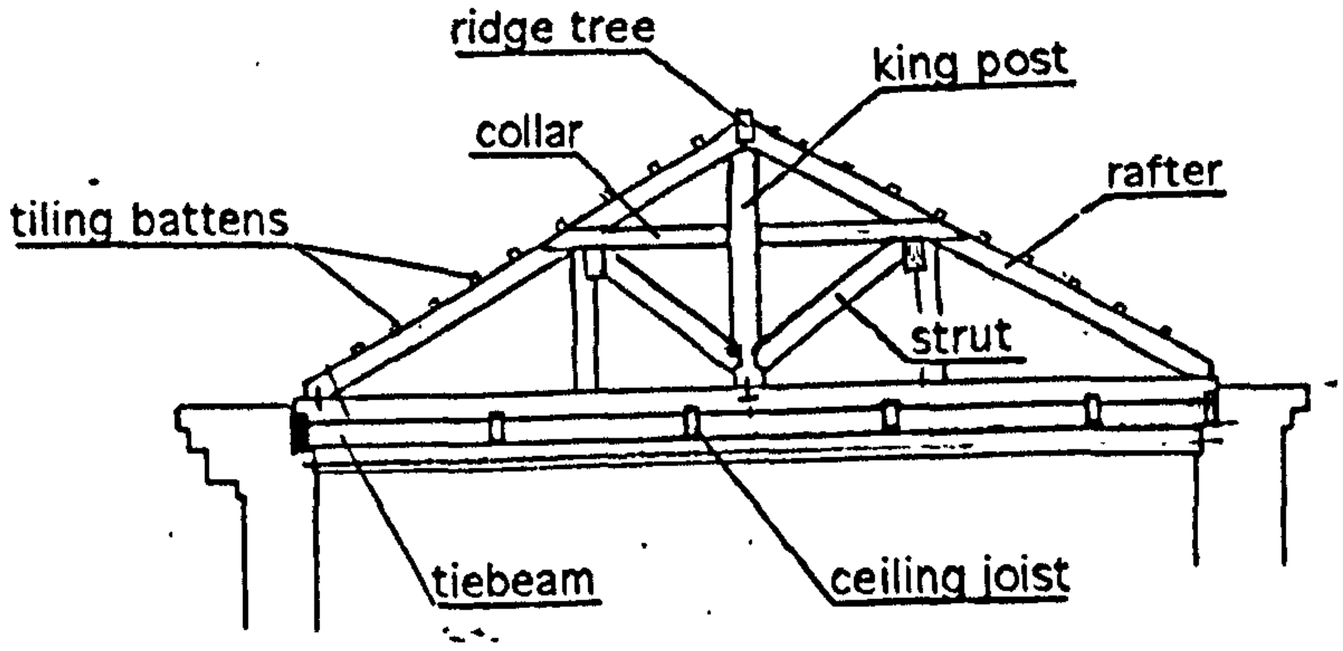


Fig.3.73- Structure of a triangular roof, section

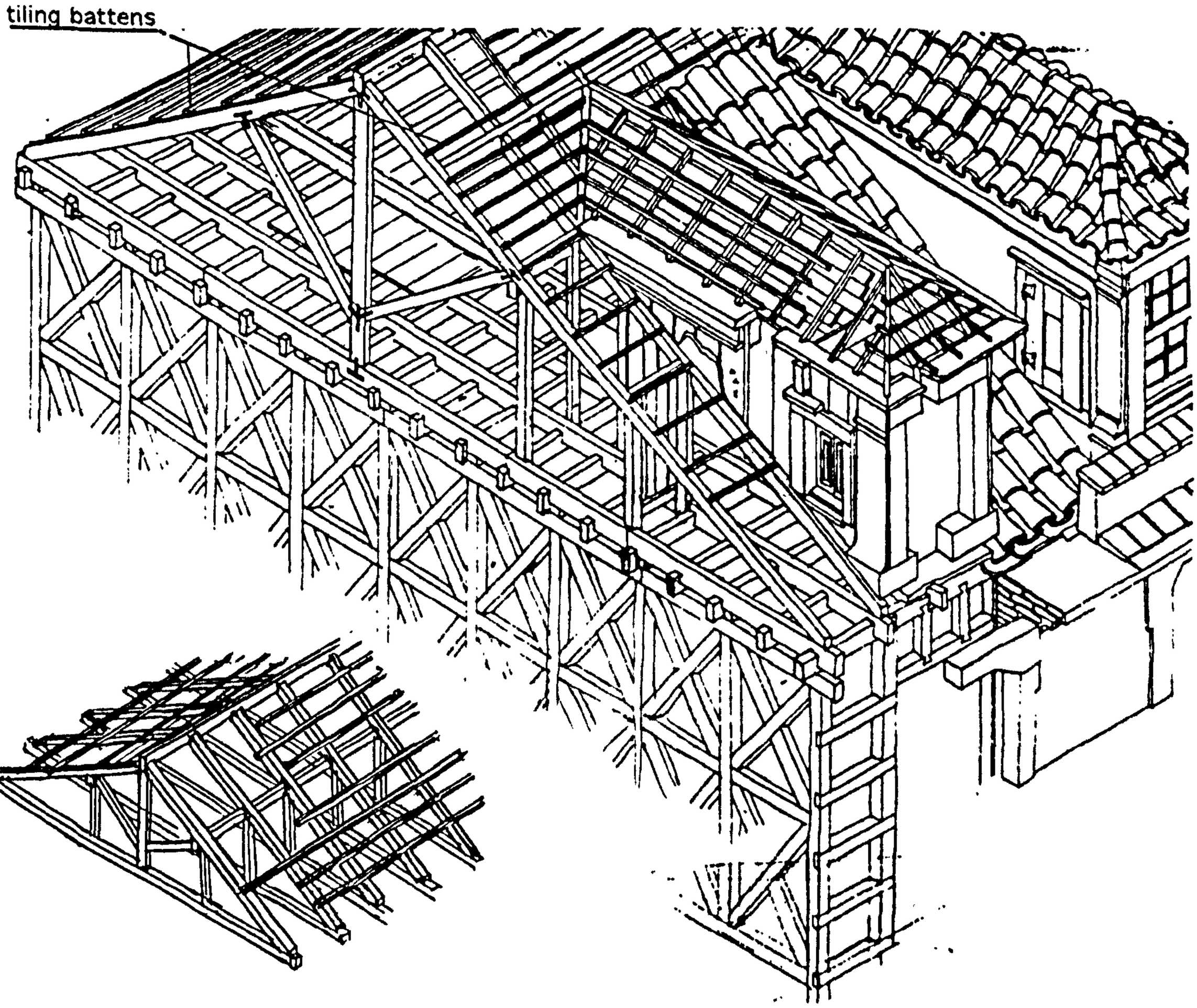


Fig.3.74- Structure of a triangular roof isometric.
(building L)

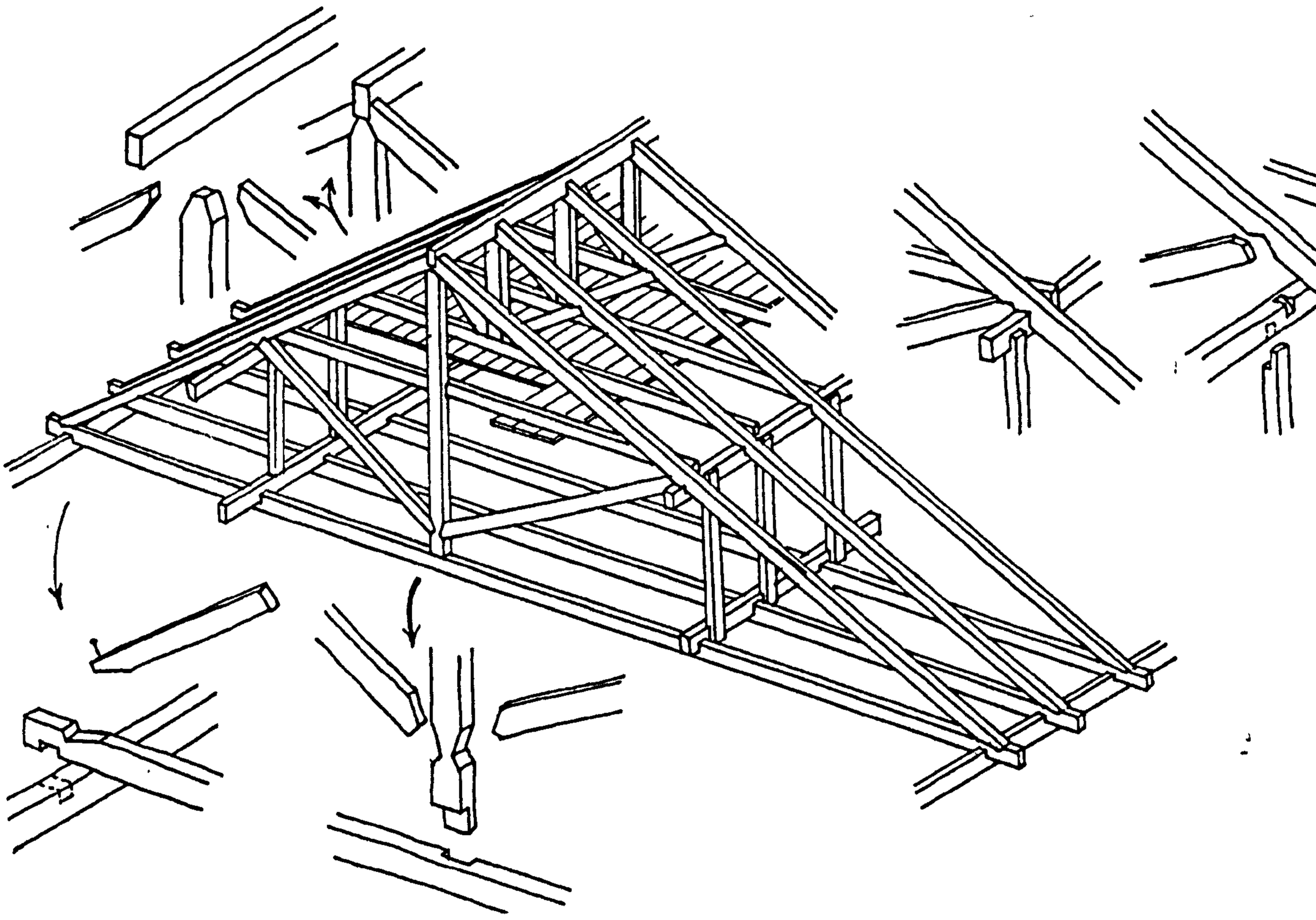


Fig.3.75- Structure of a triangular roof, details
(building B)

The common rafters are at 0.40m (40cm) centres and are supported at the ridge by a ridge tree ("trave de fileira") with a section measuring 0.18x0.08m and at intermediate points on the slope by purlins ("*madres*") with sections measuring 0.15x0.10m, the ends of which were supported on the gable walls.

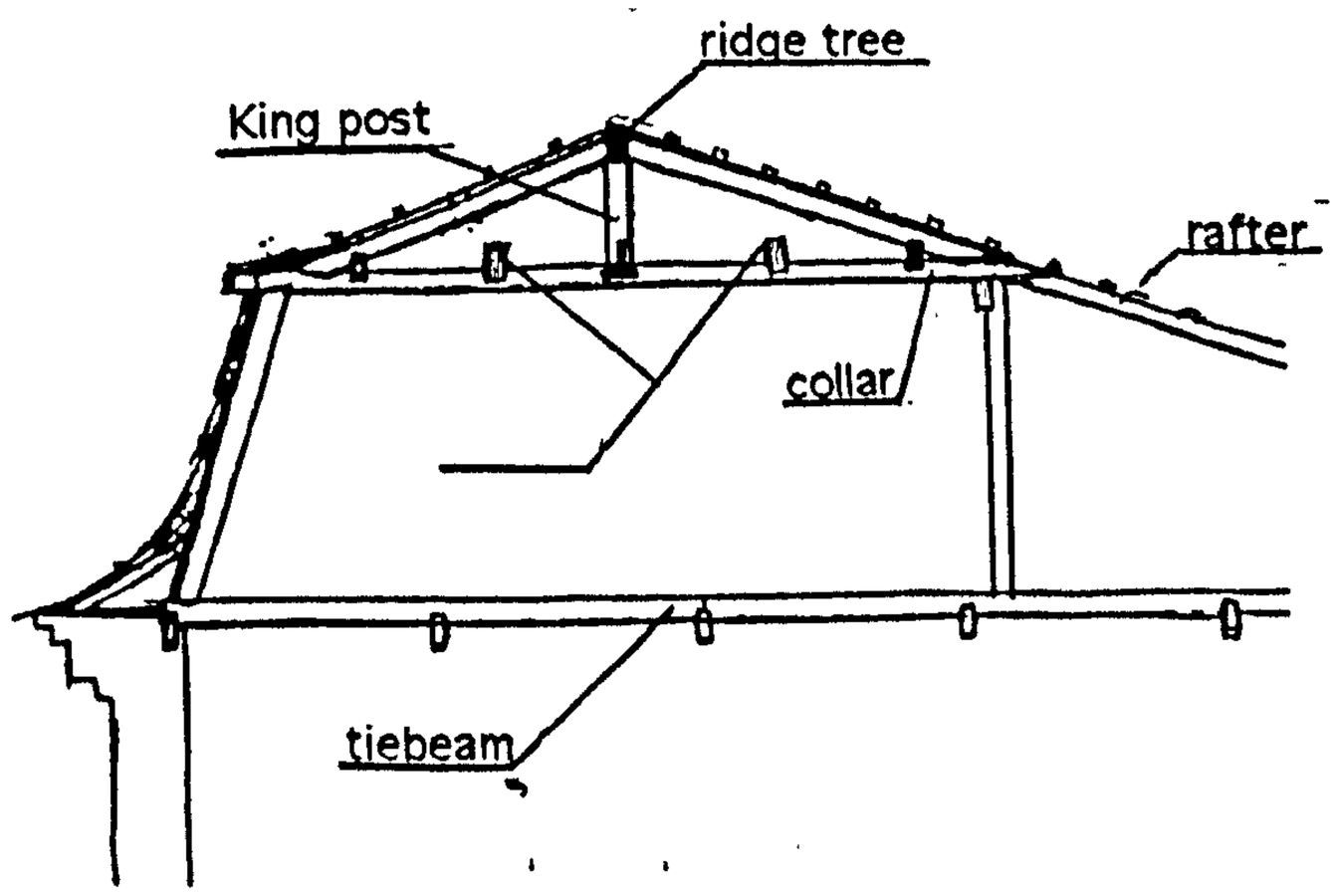


Fig.3.76- Structure of a mansard roof, section

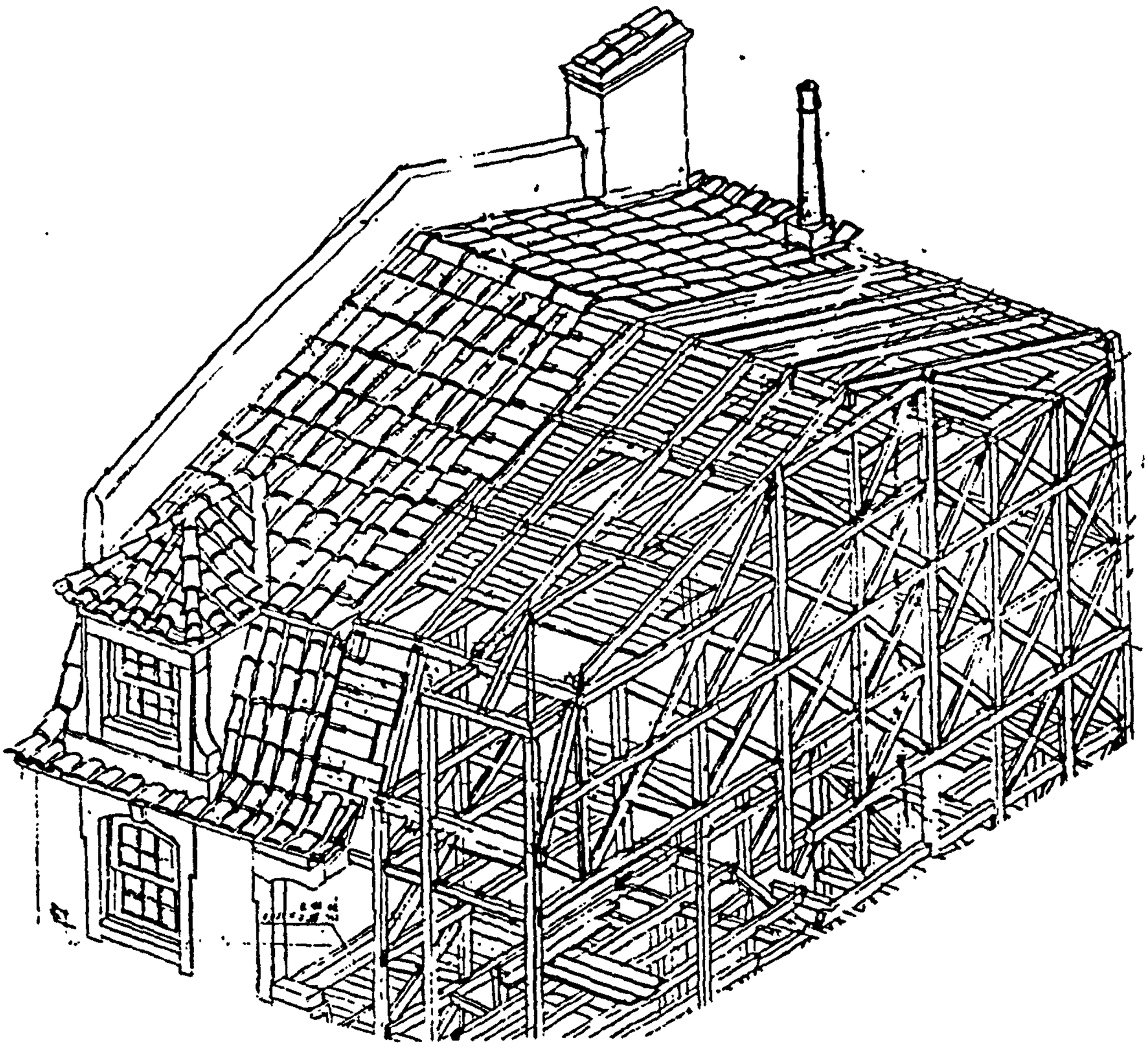


Fig.3.77- Structure of a mansard roof, isometric.

(building P)

The various parts which made up the frame structure were held together by metal connections, (building B) (Fig.3.78).

The construction of the frames was not always perfect and there were many cases, especially on the additional extensions where there were circular or semi-circular section truss members, and it often proved necessary to place props where the structure began to deflect under the weight of the tiles, (Fig.3.79 and 3.80).

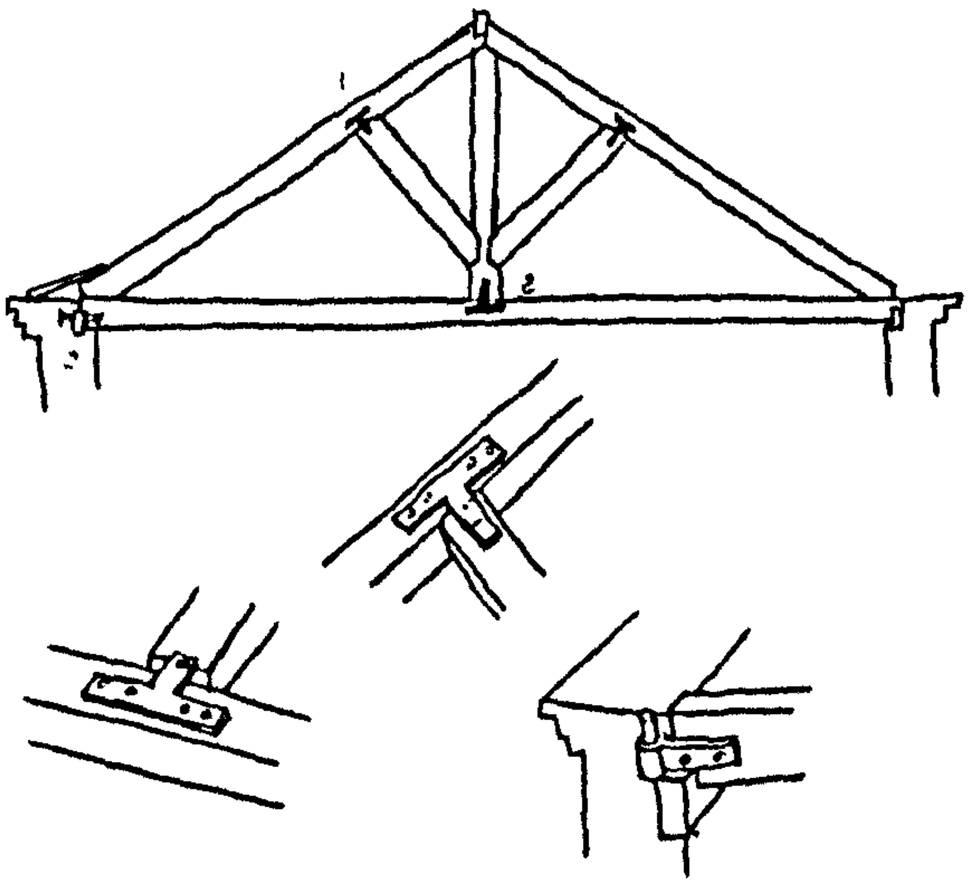


Fig.3.78-The metal connections

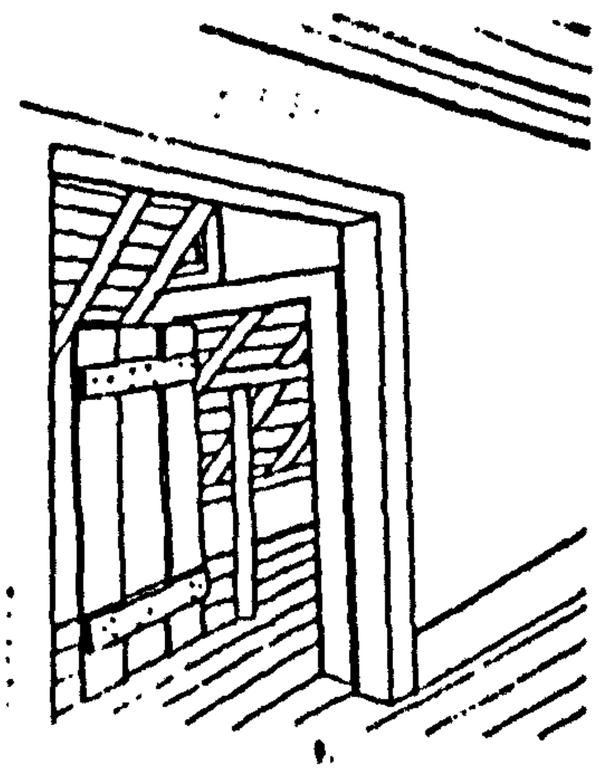


Fig.3.79-The trusses were not always perfect, 28, Comércio Street

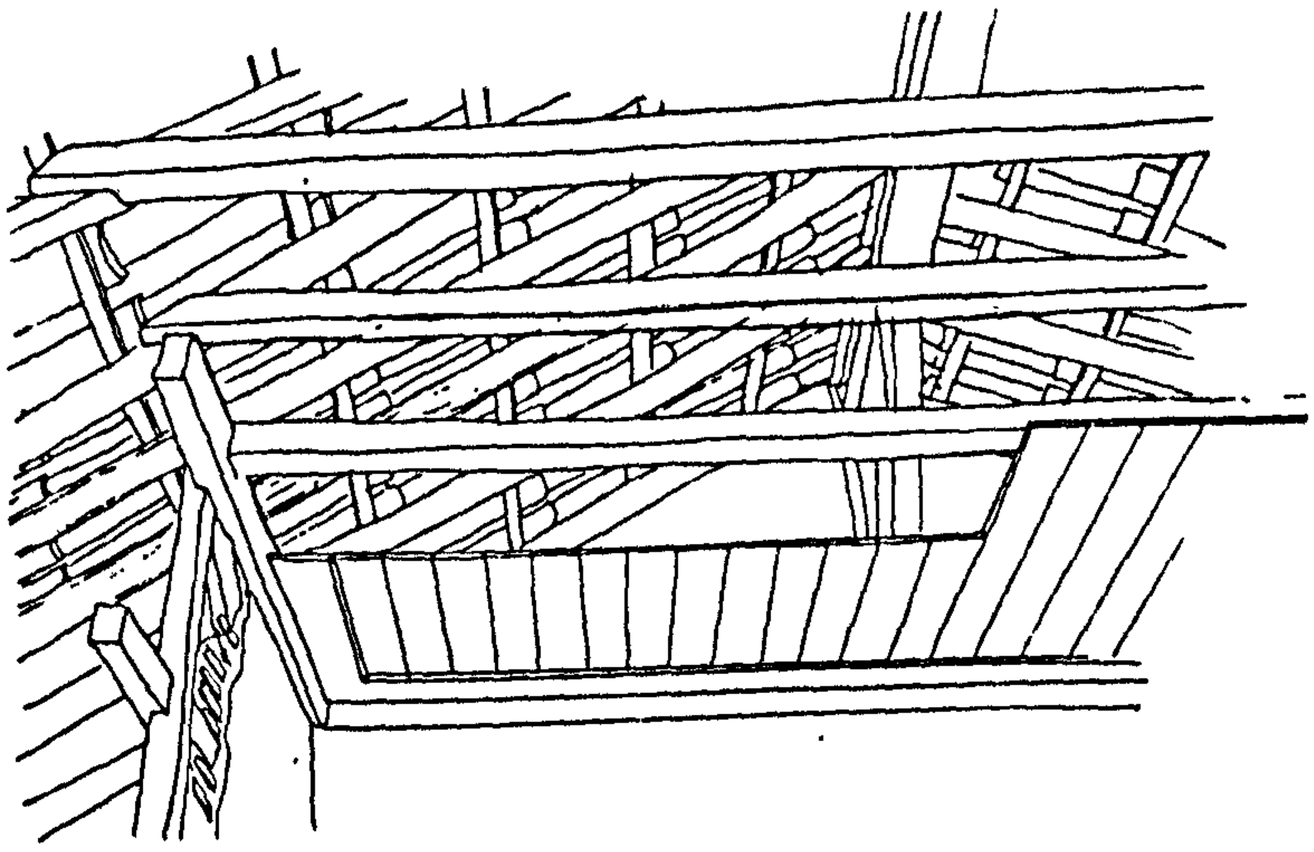


Fig.3.80-Aspect of the structure from inside
(building P)

Thin planks were sometimes nailed on top of the rafters perpendicular to them. As the planks were not jointed on their edges, they never fitted neatly and the joints were therefore covered with wooden strips which acted as tiling battens. As a covering, Spanish tiles were used which allowed for the construction of an elegant and long-lasting roof but one that was quite heavy.

The tiles were laid down forming strictly parallel channels, following the direction of the roof slope and above the cornices of the façades were eaves with gentle slopes using three tiles, which became progressively more horizontal, towards the eaves with the help of sprockets nailed to the ends of the rafters, (Fig.3.81, 3.82, 3.83 and 3.84).

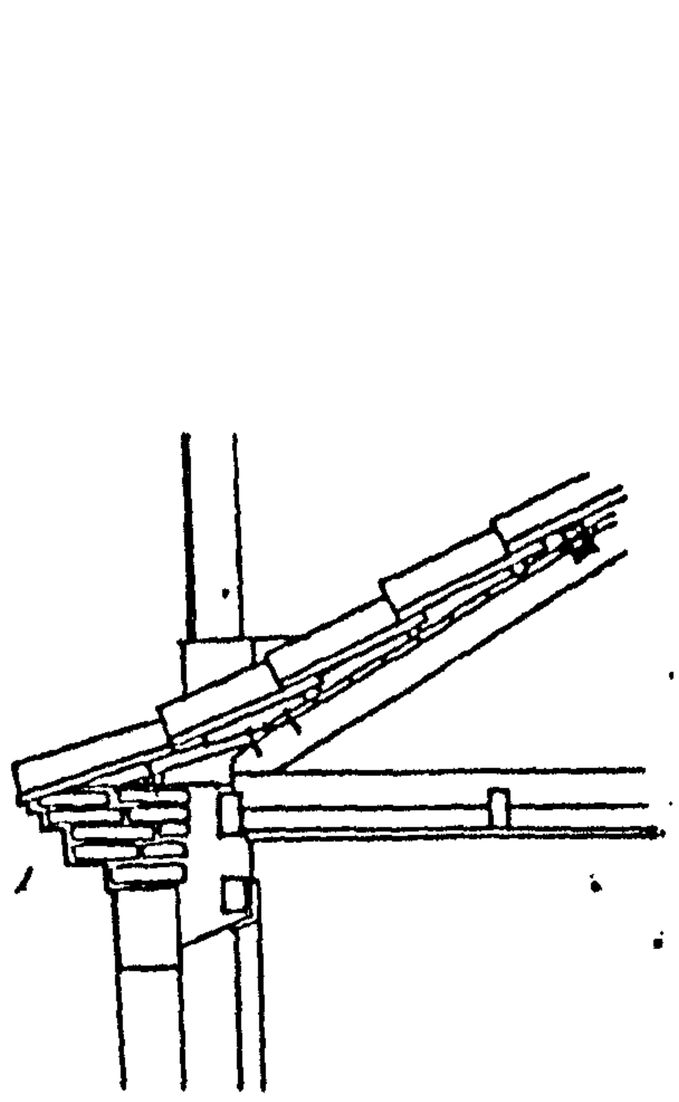


Fig.3.81-Tilting of the tiles at the eaves, section
(building L)

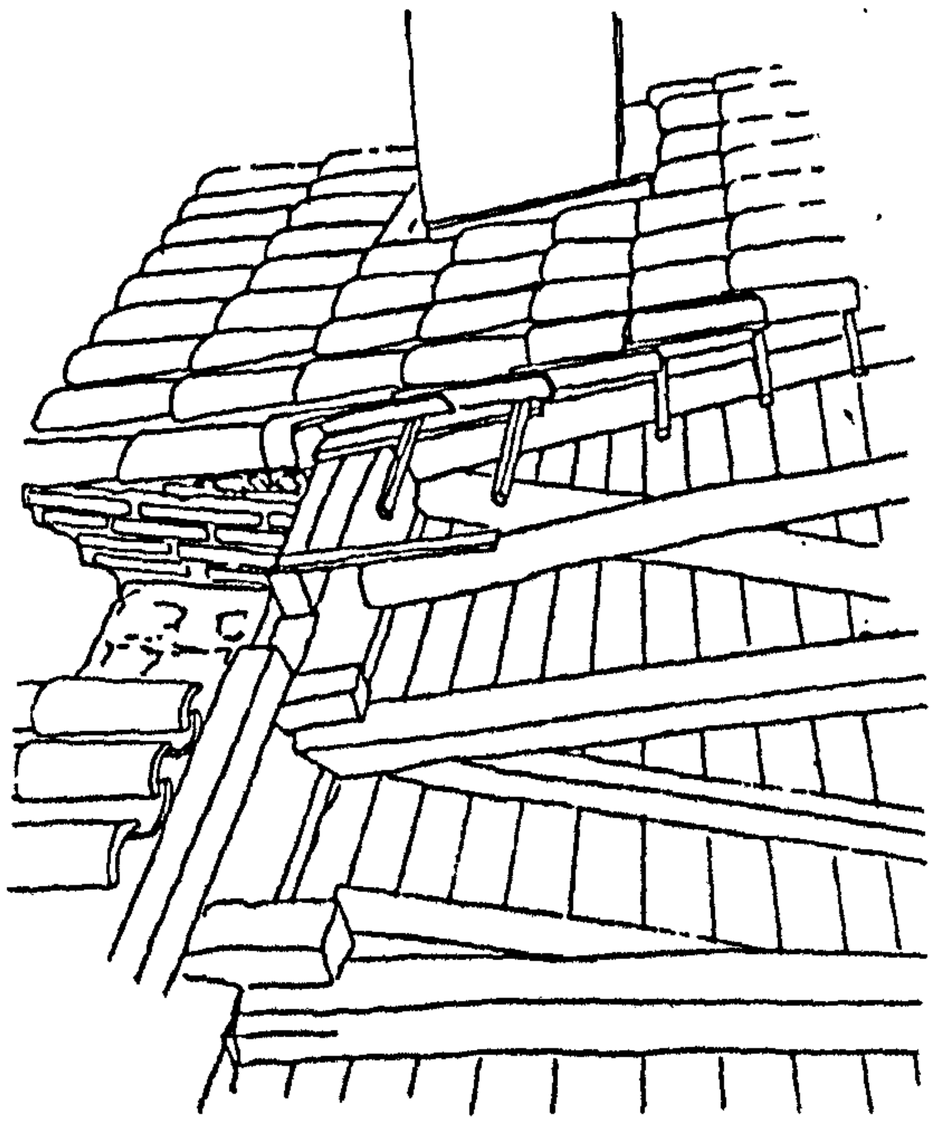


Fig.3.82-Tilting of the tiles at the eaves 1
(building B)

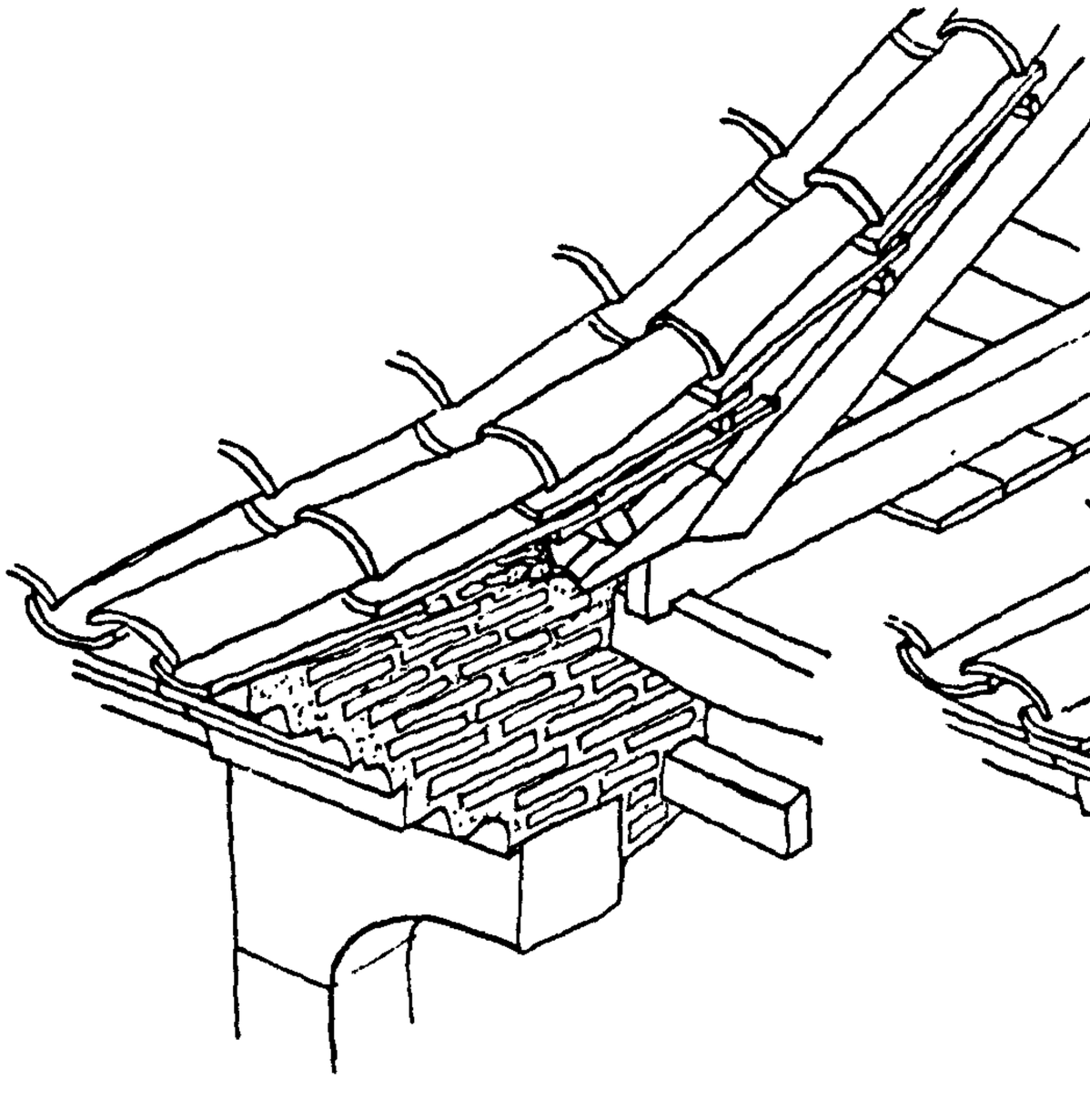


Fig.3.83-Eaves, street wall façade
(building B) made with bricks

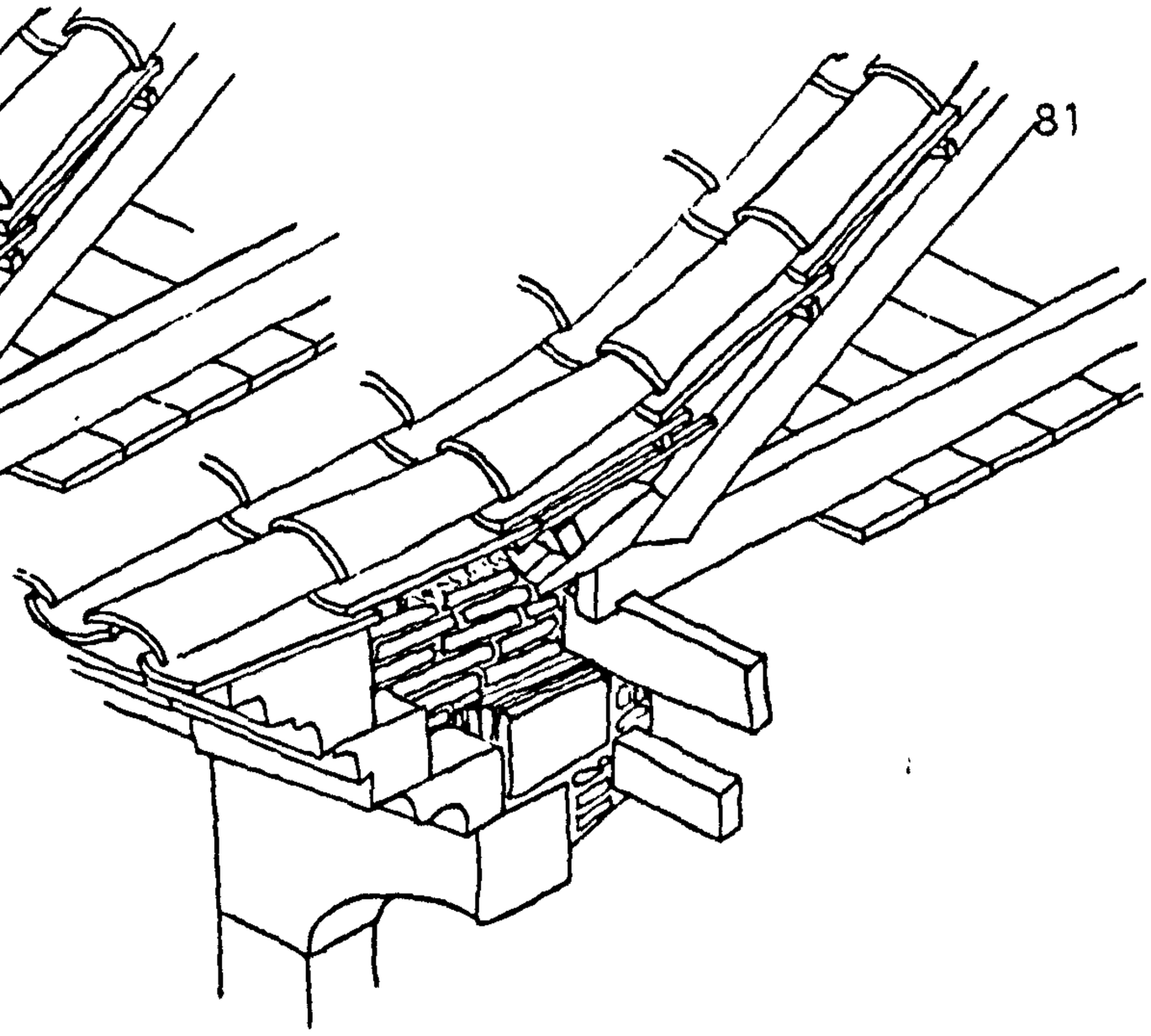


Fig.3.84-Eaves, street wall façade
(building P) made with stone

The lowest tiles on the eaves were bedded in mortar to prevent them falling onto passers by, which was a danger especially with the steeper slopes of the mansard roofs; In order to allow for easy access to the roof for cleaning or repair purposes, tiles were placed over the channel next to the dormer windows. These were laid transversely and bedded on mortar, in order to act as steps, (Fig.3.85).

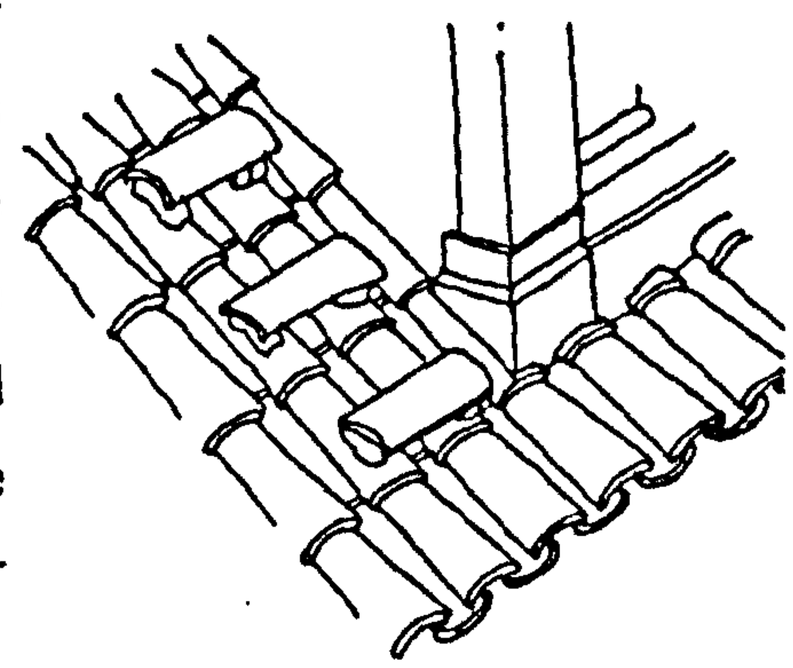


Fig.3.85-Access for cleaning or repair
(building L)

The dormer windows were always made with a ridge aligned with the roof frame. The dormer cheeks have a compact structure on the inside formed of vertical and horizontal planks which are supported by the two adjacent rafters, (Fig.3.86, 3.87, 3.88, 3.89 and 3.90). The perimeter of the habitable area of the roof was defined by wooden partitions.

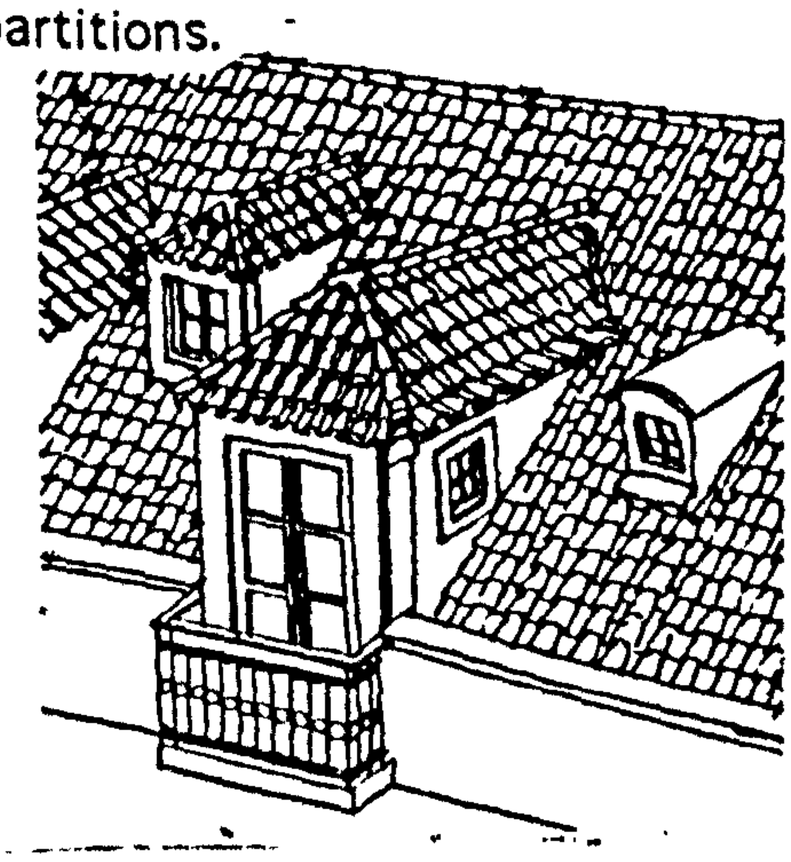


Fig.3.86-Dormer windows
S. Nicolau Street

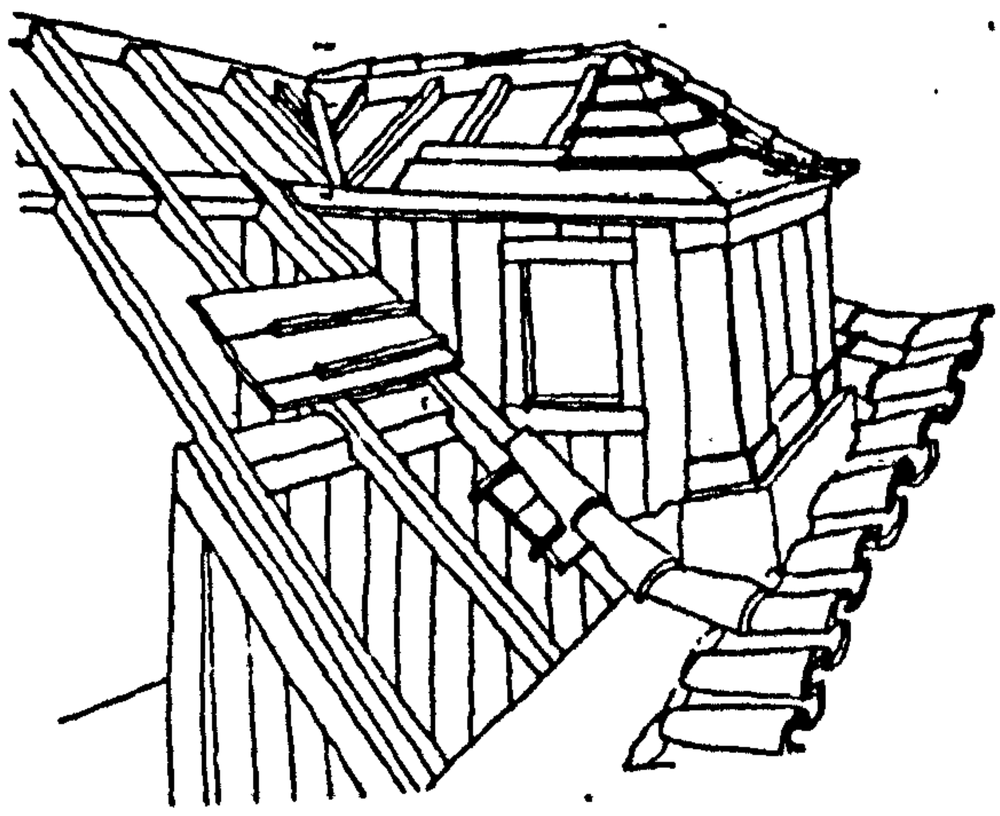


Fig.3.87-Dormer windows
detail of construction (building L)

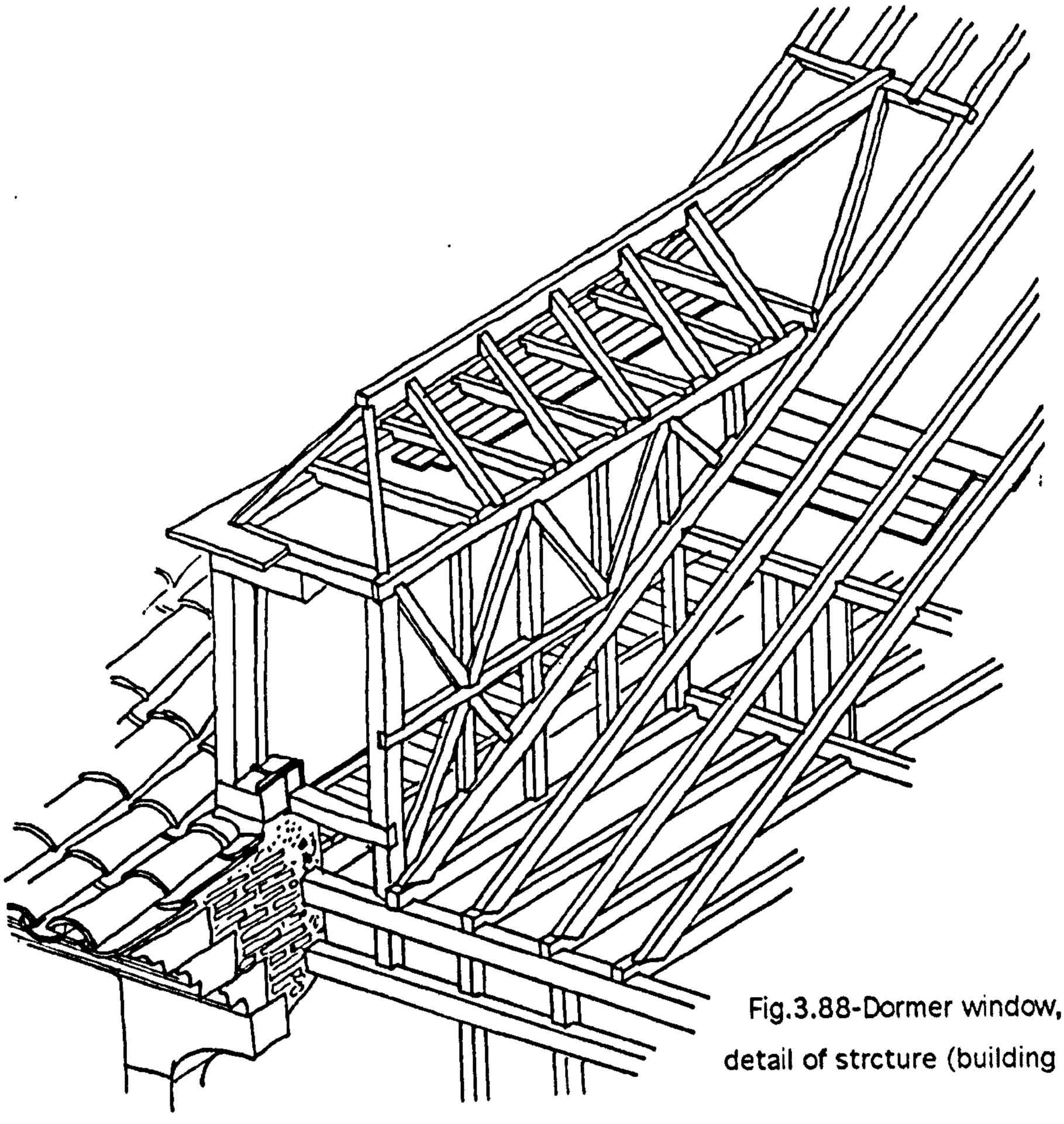


Fig.3.88-Dormer window,
detail of strcture (building B)

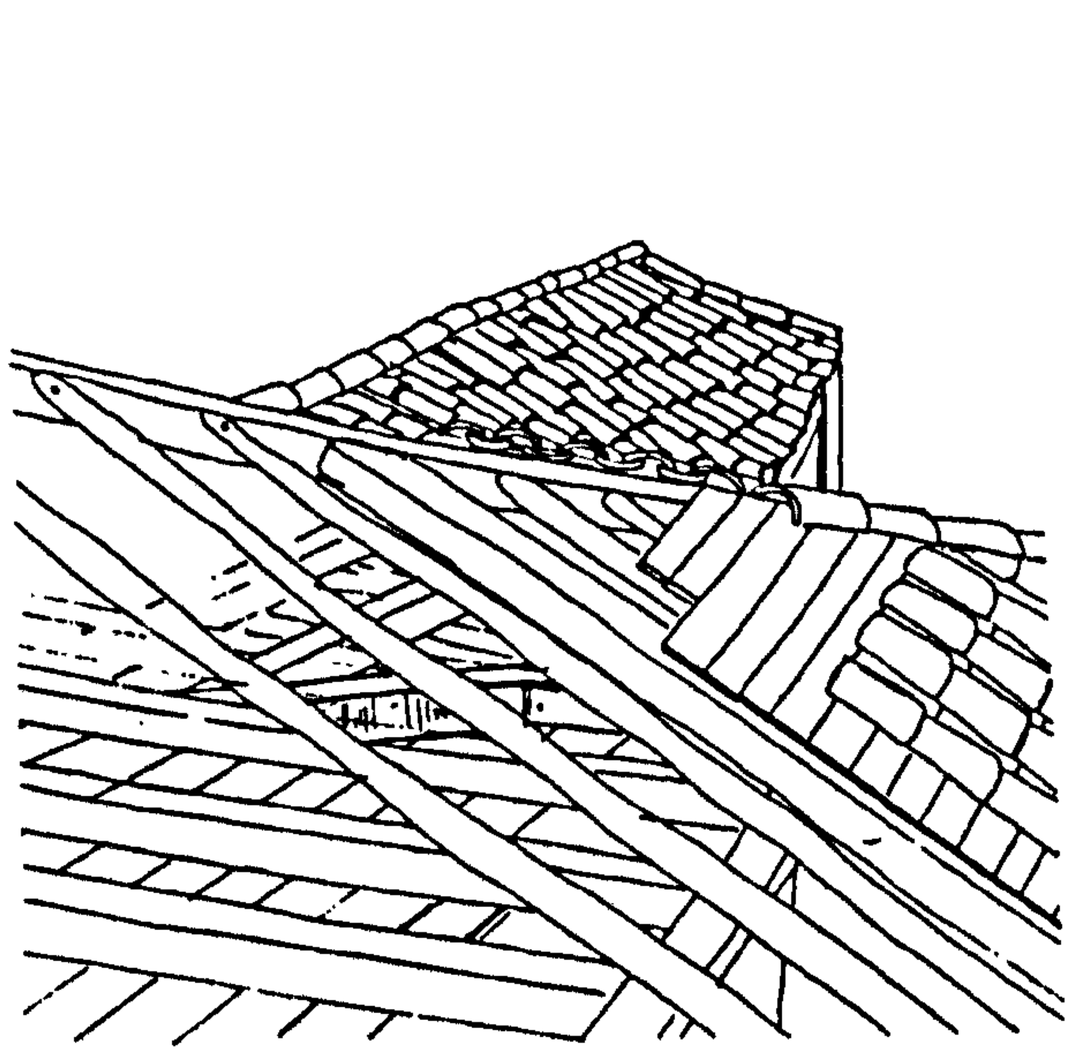


Fig.3.89-Dormer windows ,
detail of construction (building P)

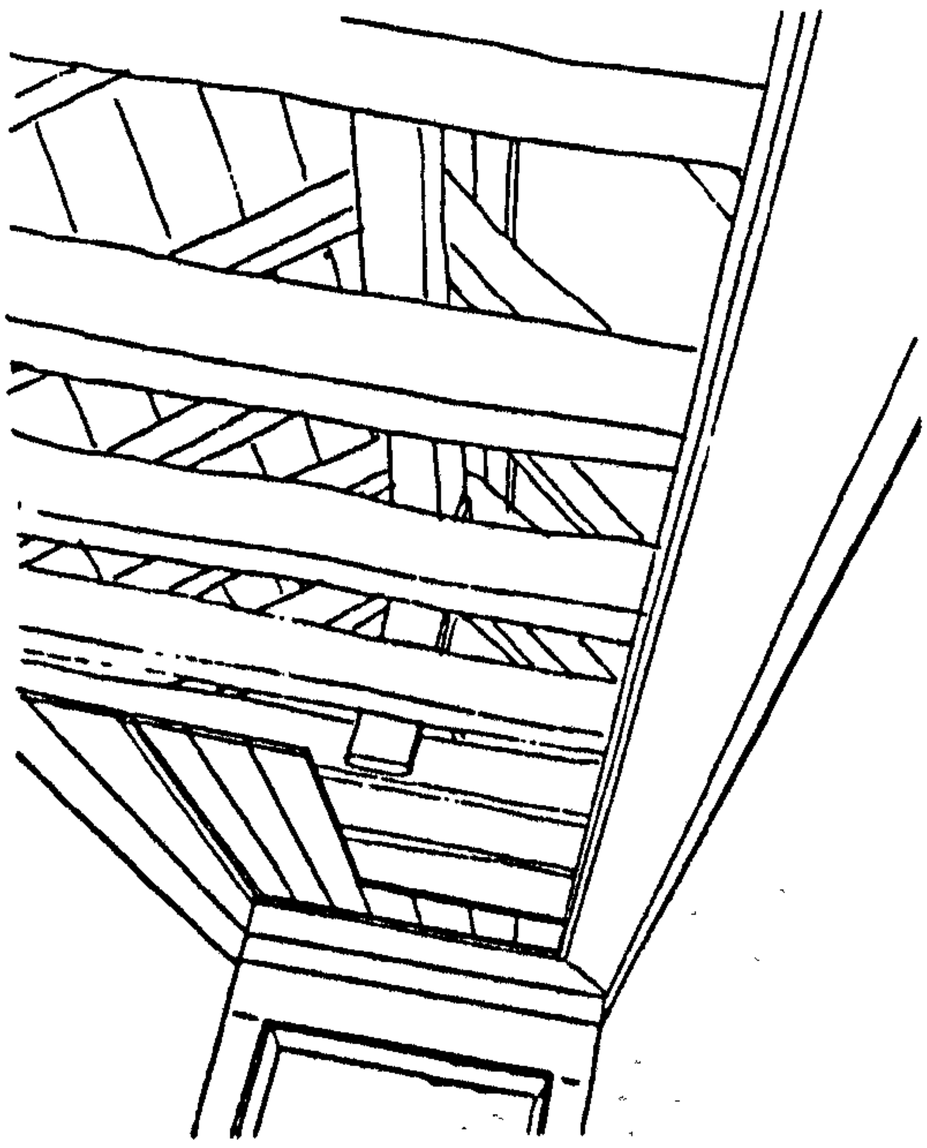


Fig.3.90-Dormer windows ,
from inside (building P)

3.7 Skylights, floors and ceilings

The construction process usually consisted of extending the stairwell structure above the roof and covering the inside with planks and the outside with metal plates, (Fig.3.91 and 3.92).

A structure of riveted metal struts held the glass which was fixed to it with lead, except for the lower edge, which was rounded and was free to move with the expansion caused by the heat.

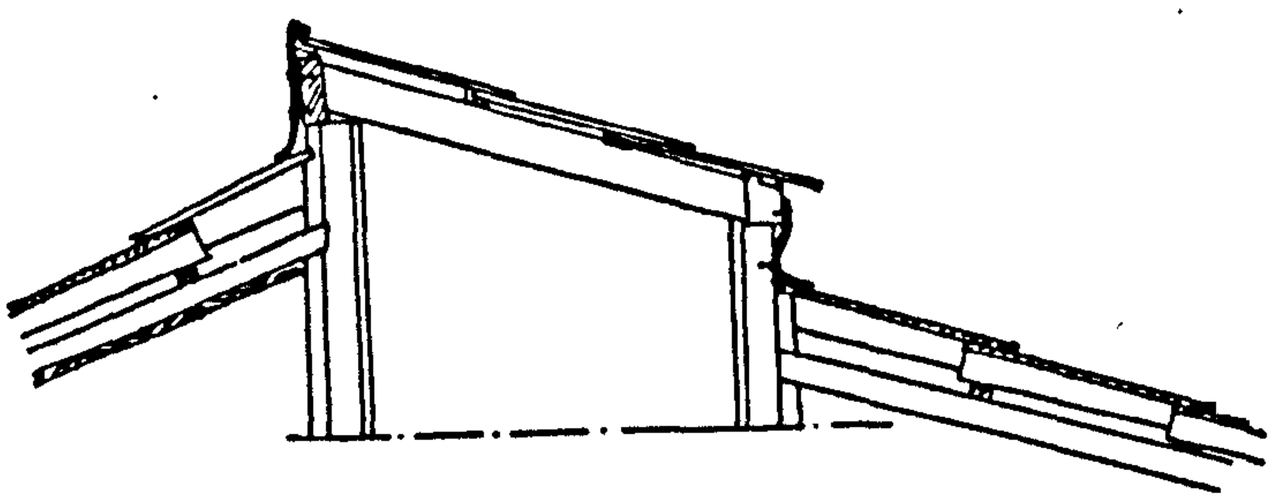


Fig.3.91-Section through skylight monopitch (building J)

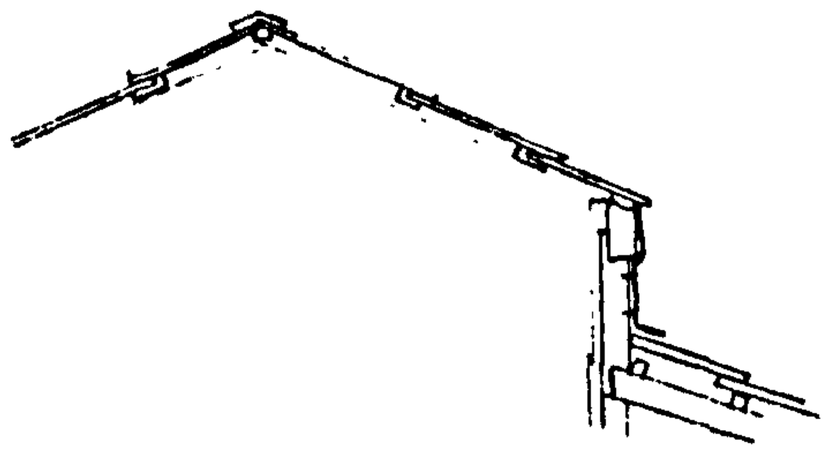


Fig.3.92-Section through dual pitch skylight. (building D)

Usually the floor joists extend from one external wall to the other, (Fig.3.93).

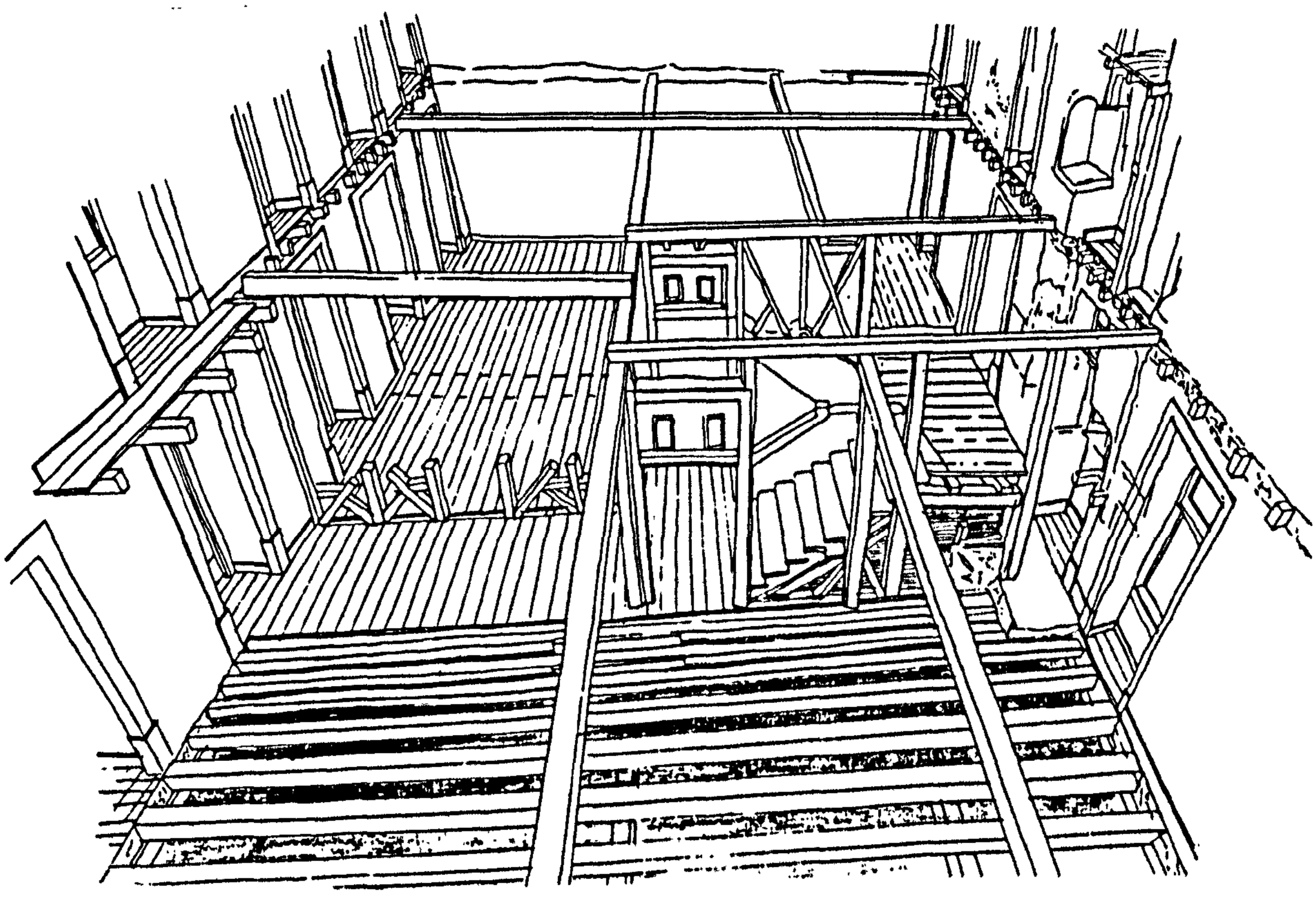


Fig.3.93-View of the structure of floors (building B)

Their bearings ends were always supported on tranverse beams inside the external walls, reinforced with iron straps, (Fig.3.94 and 3.95) except near the balcony (Fig.3.96)

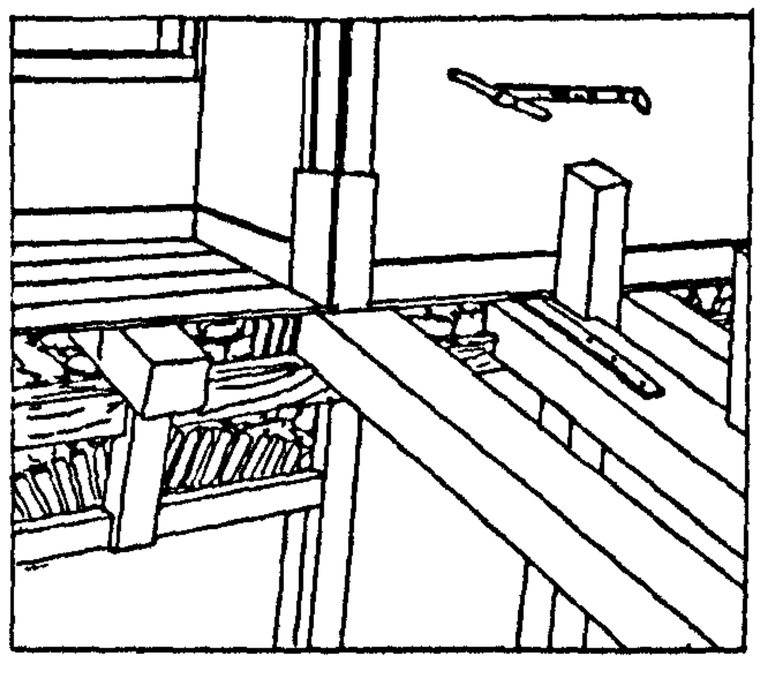


Fig.3.94-Connection of the floor joists to the walls (building D)

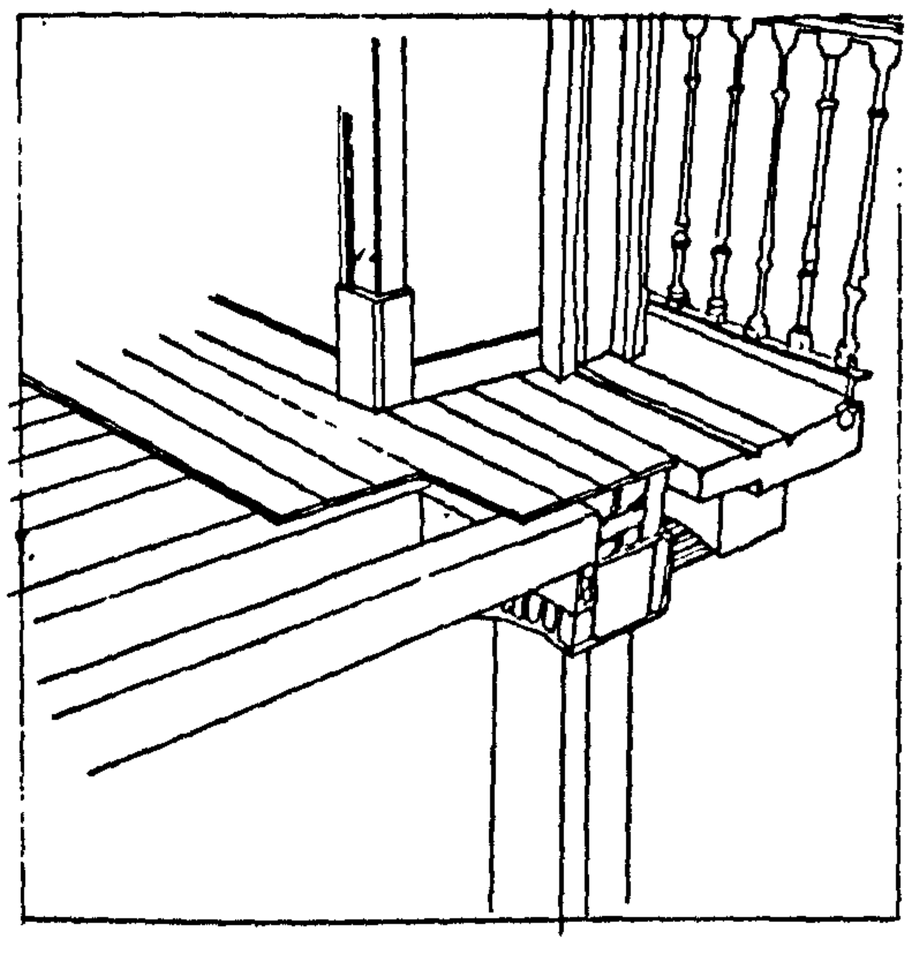


Fig.3.95-The beams at the balcony (building D)

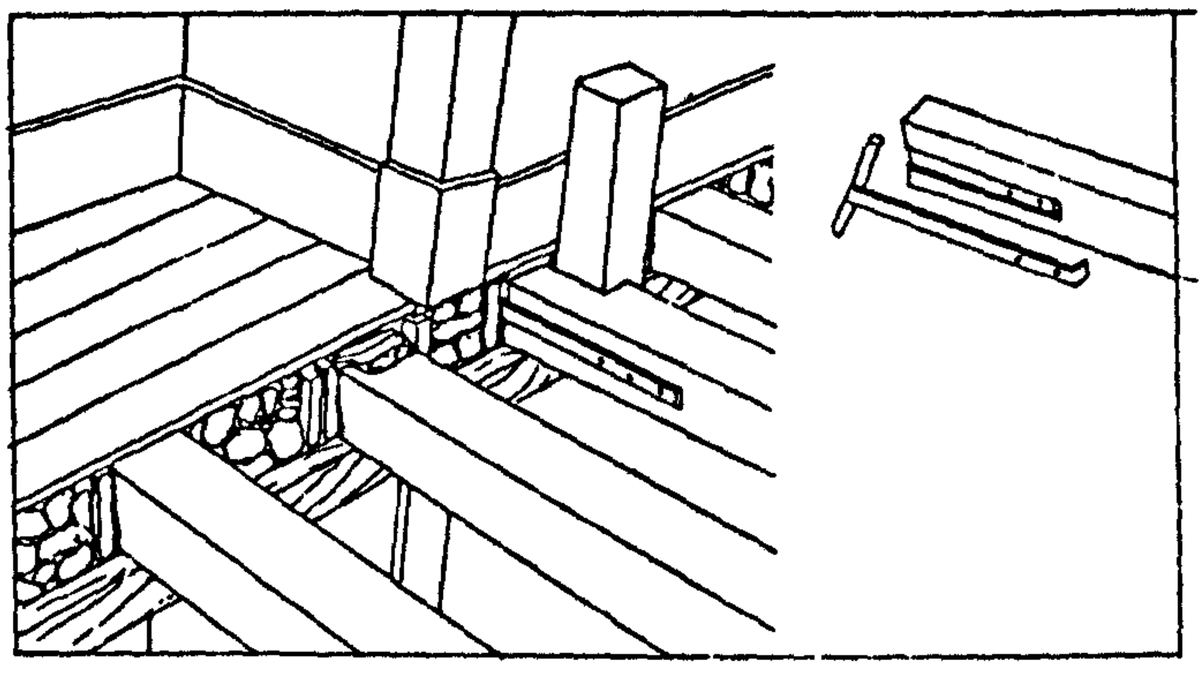


Fig.3.96-Connection of the floor joists to the walls (building D)

The joists adjacent to the cross walls are fixed to them with iron straps, (Fig.3.97). Openings for chimneys and stairs are formed with trimmed, trimmer and trimming joists as in UK construction, (Fig.3.98).

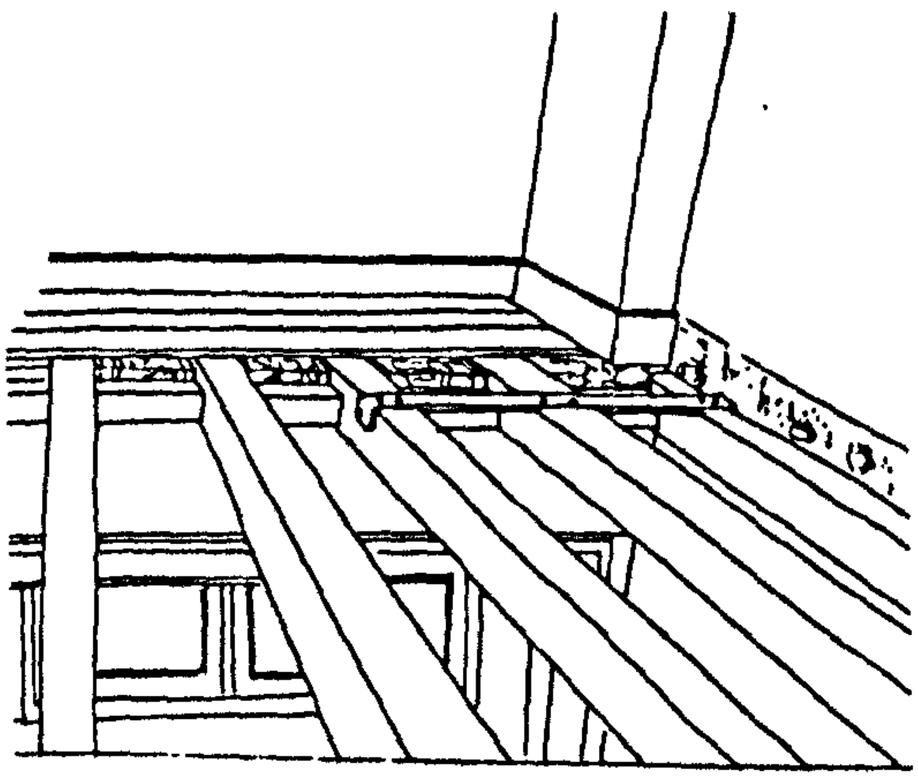


Fig.3.97-Joists strapped to cross walls (building B)

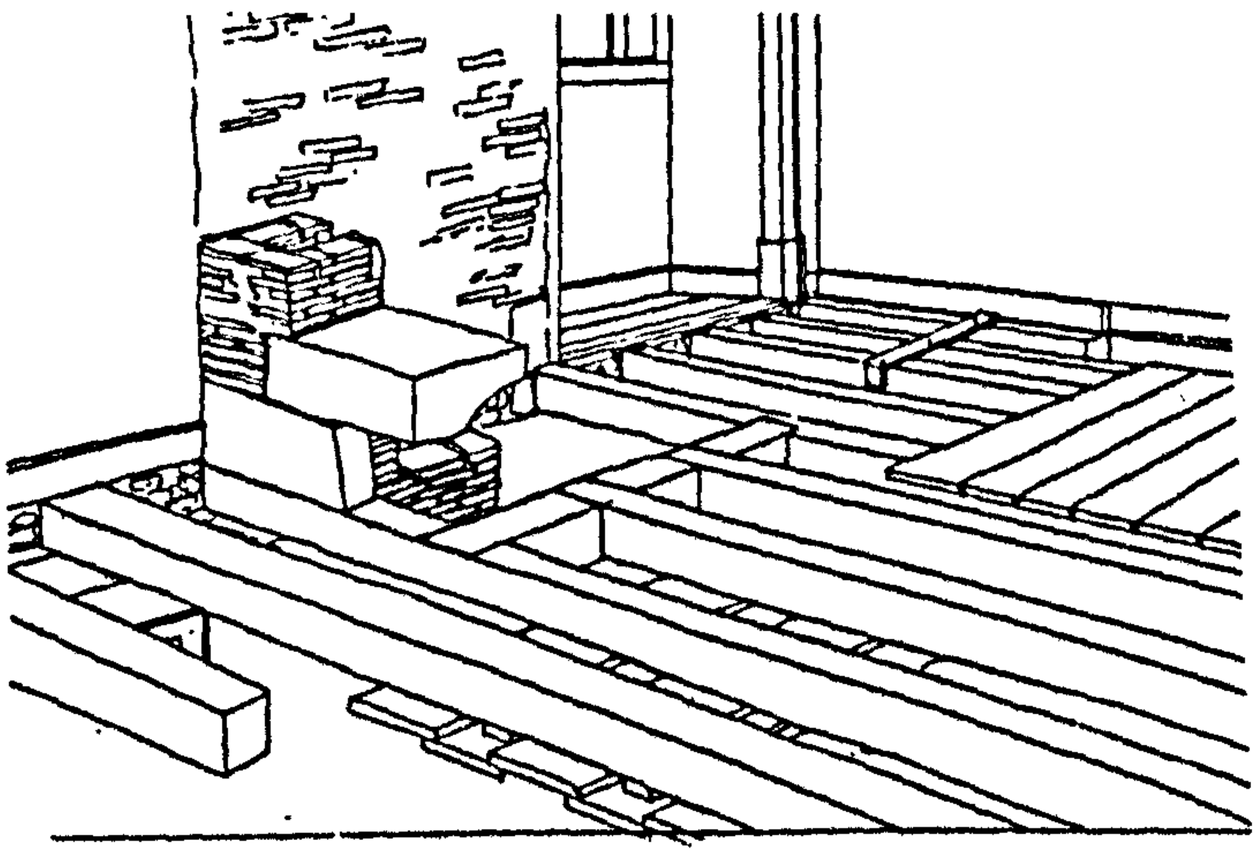


Fig.3.98-Trimming for a chimney (building B)

Timber or brick nogging was used to maintain the joist spacing over internal walls, (Fig.3.99 and 3.100).

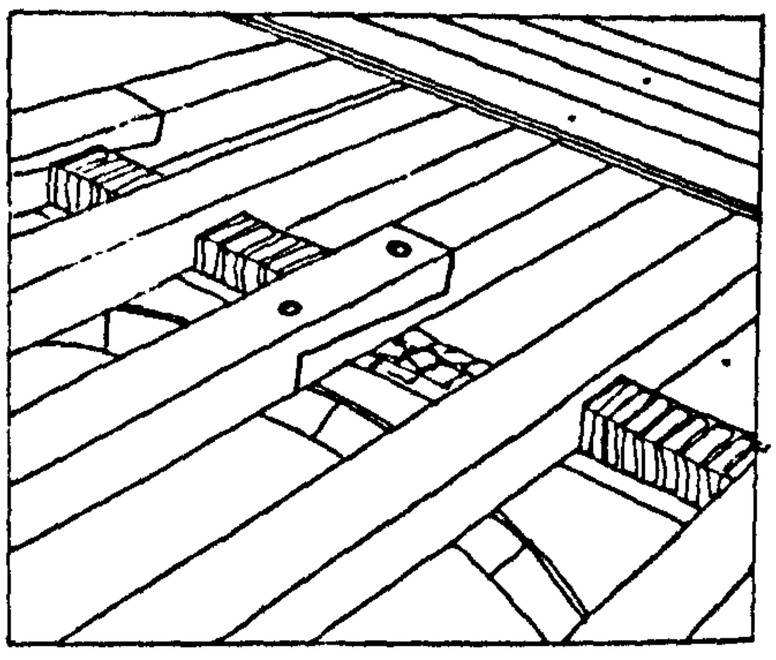


Fig.3.99-Brick nogging (building E)

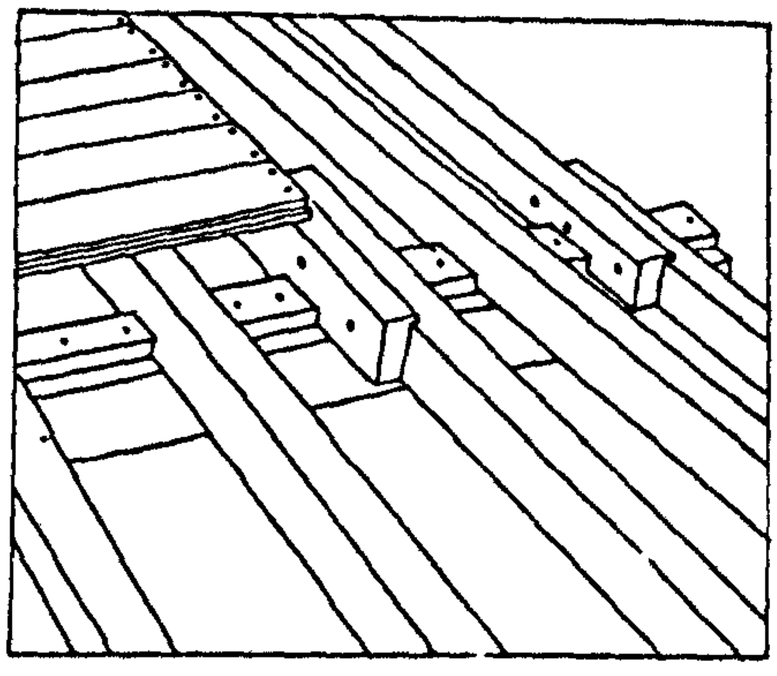
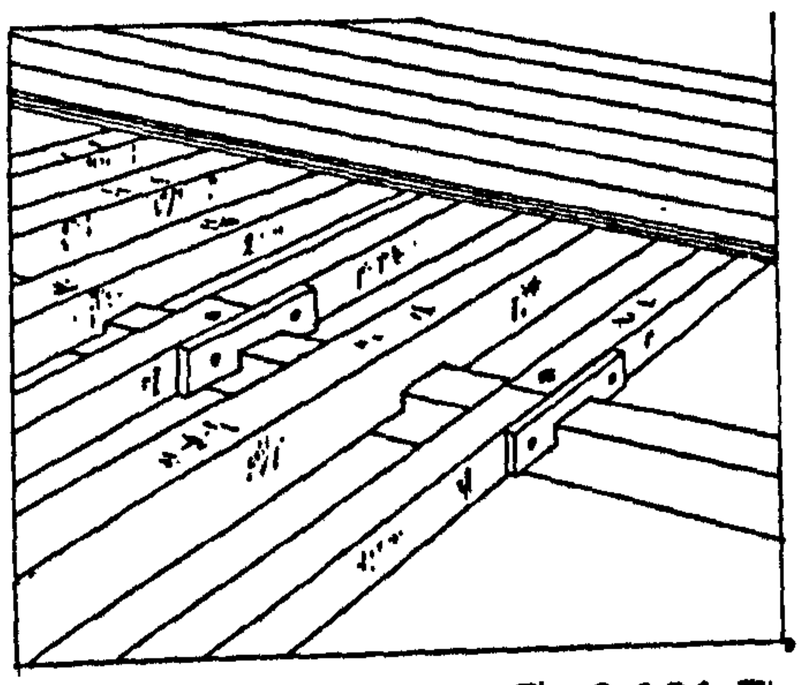


Fig.3.100-Timber nogging (building D)

When joists are jointed over internal walls, only every other joist is jointed over any one wall, (Fig.3.101).



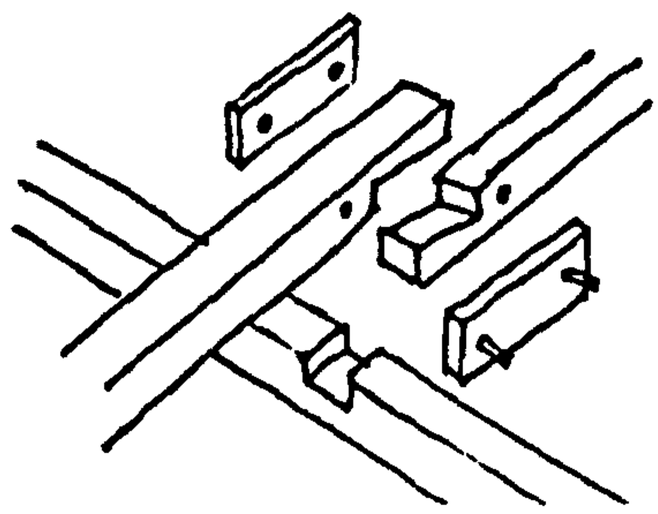


Fig.3.101-The alternating joints

(building B)

The floors consist of pine boards, without knots, planed on both sides and of equal width, (Fig.3.102). They were joined in the Portuguese way with rebates, 0.022m in depth, (Fig.3.103). The width of the floor boards could vary by 0.16m on the landings and by 0.08/09m in more refined areas. To make the floor more resilient and comfortable, there are softwood packing pieces below the boards, on top of the joists, (Fig.3.103).

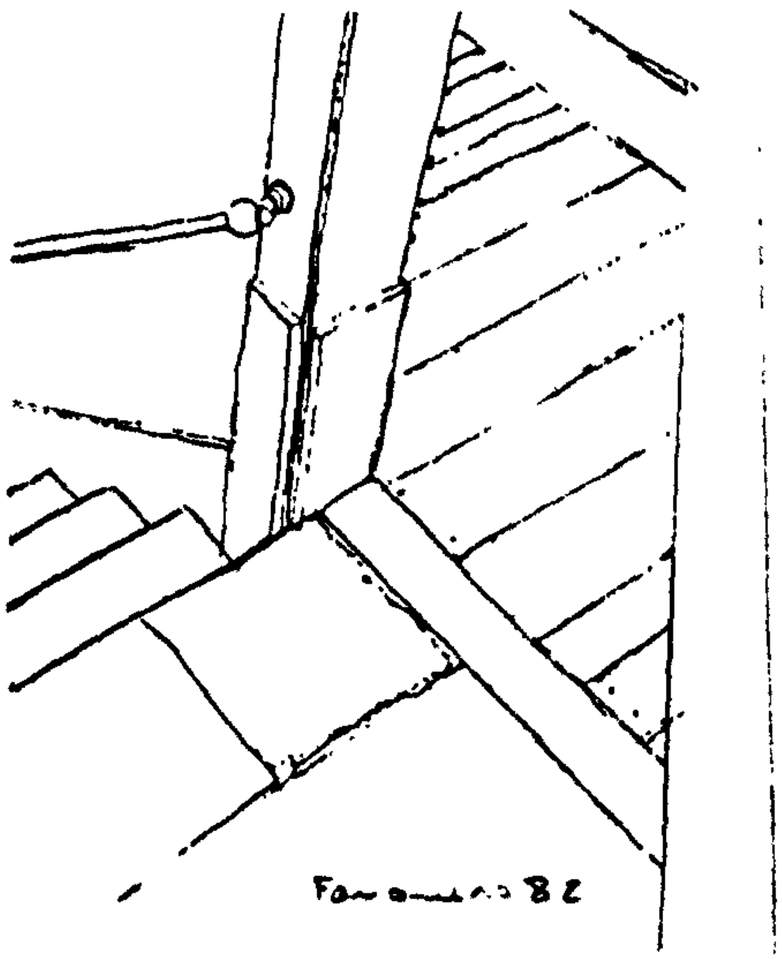


Fig.3.102-Transition from stone to wood floor

82, Fanqueiros Street

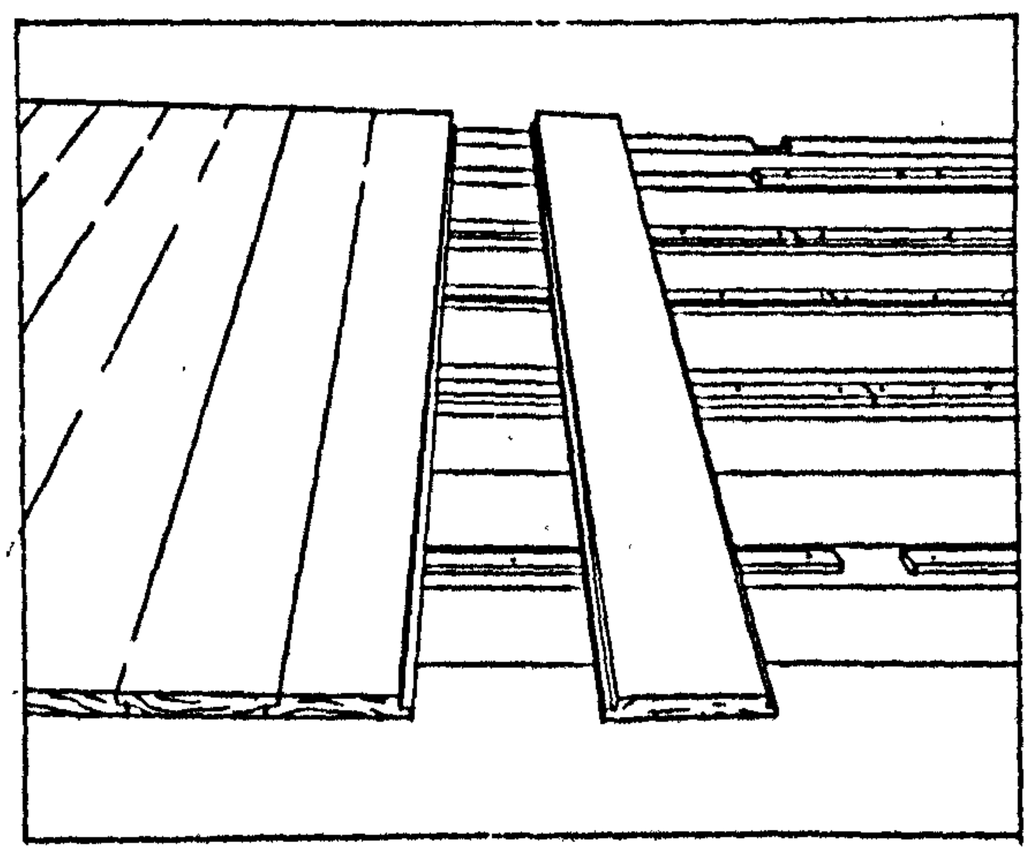


Fig.3.103-The boards joined *"à Portuguesa"*

391, Vitória Street

On the upper levels, the wooden floors were plain, that is to say, all the boards were perpendicular to the joists, (Fig.3.104).

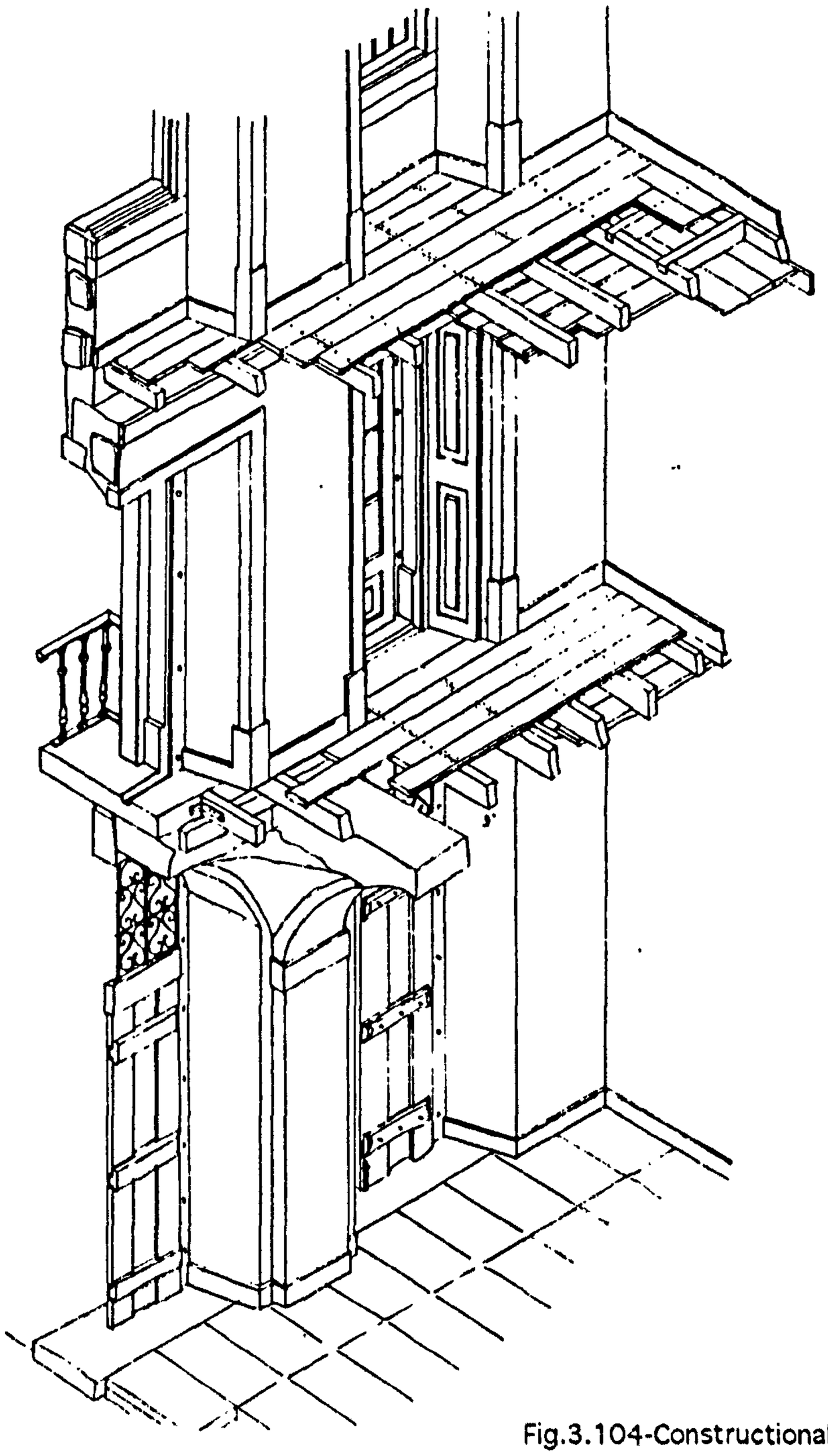


Fig.3.104-Constructional detail of floors and ceillings (building P)

There are many cases where in the sitting rooms next to the walls, two boards were placed perpendicularly and in the corners there were 45° mitres. This type of floor was called "encabeirado", meaning, with boards placed parallel to the walls around the perimeter (Fig.3.105). For this purpose, noggings were inserted next to the walls. The skirting boards were planed on one side only and nailed to the cage supports.

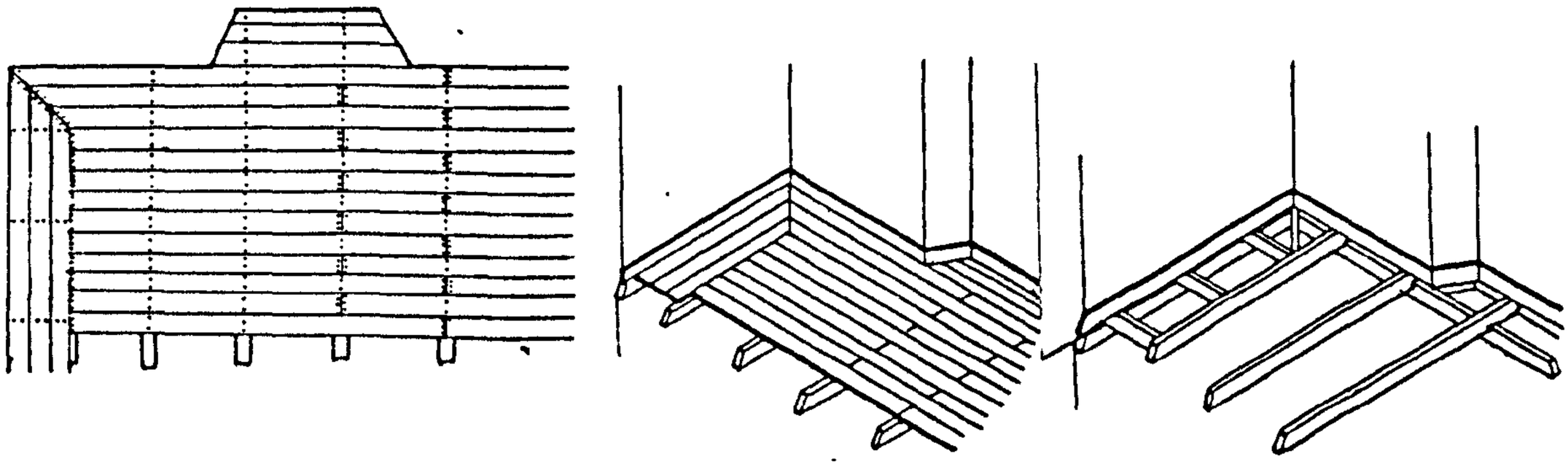


Fig.3.105-"Encabeirado" floor, plan, isometric and structure, 82, Fanqueiros Street.

The ceilings were made of boards, planed only on the side that was visible. Firstly, boards were nailed directly to the joists with gaps between them. Subsequently, further boards with cavetto-moulded edges were planted over the gaps, lapping over the edges of the previously fixed boards, (Fig.3.106 and 3.107). This type of lining was called "overlapping mat style". The whole lining was "*encabeirado*", as, next to the walls, there was a concave border where the walls and the ceiling met, which was supported by noggings provided for the purpose, (Fig.3.108).

There were also lath-and-plaster ceilings, (Fig.3.109).

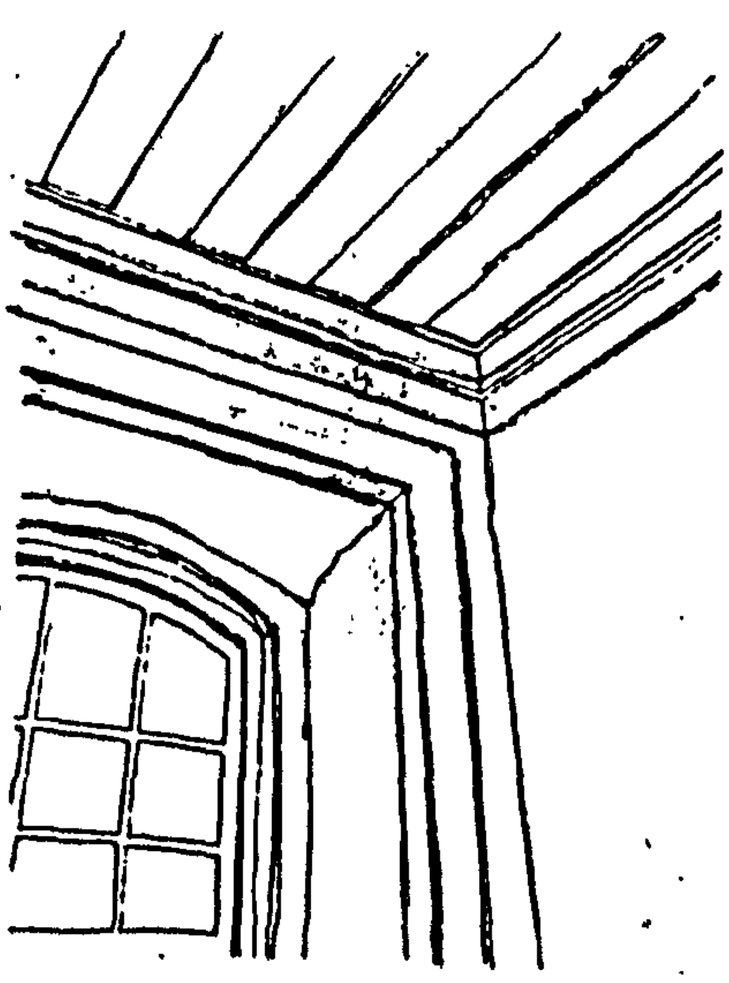


Fig.3.106-Ceiling in a corner of a room
38, Vitória Street

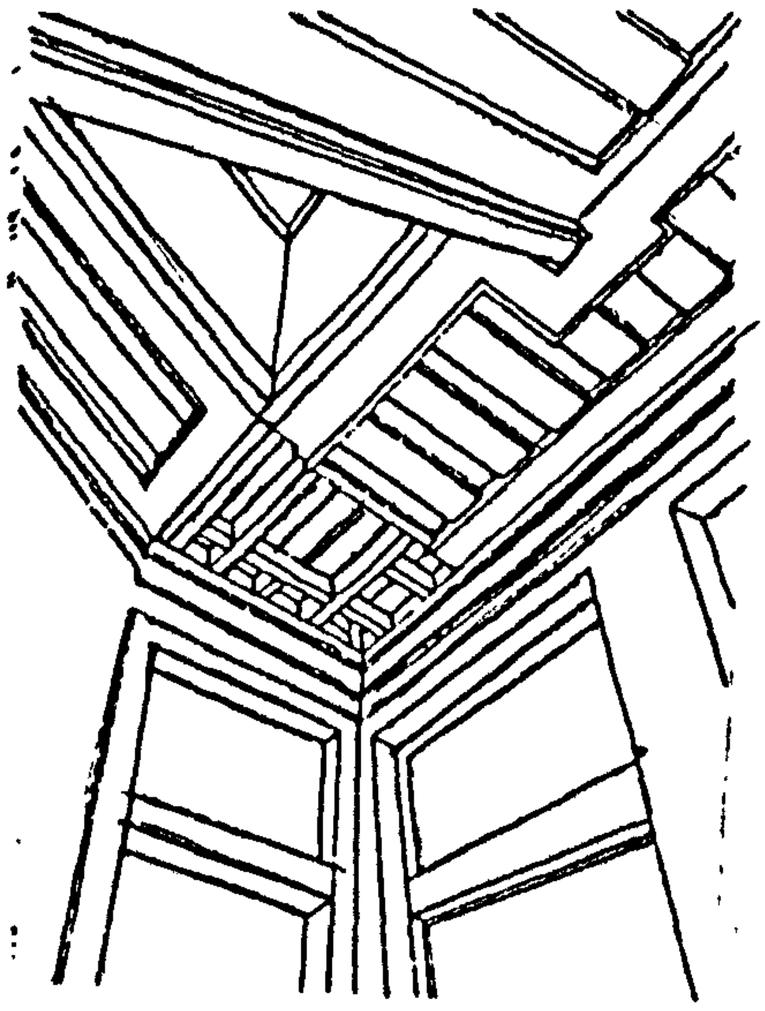


Fig.3.107-Ceilings on stairs
(building M)

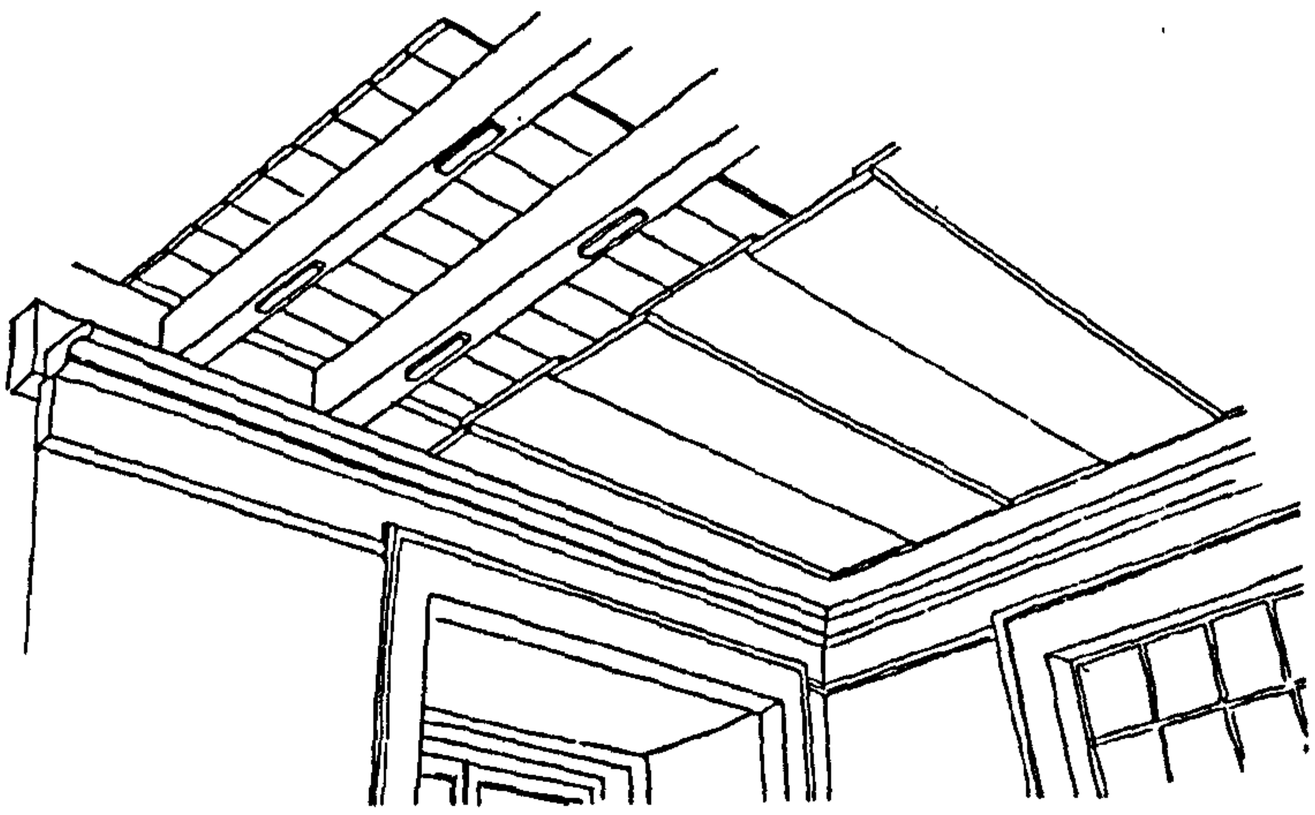


Fig.3.108-Ceilings: details of construction (building M)

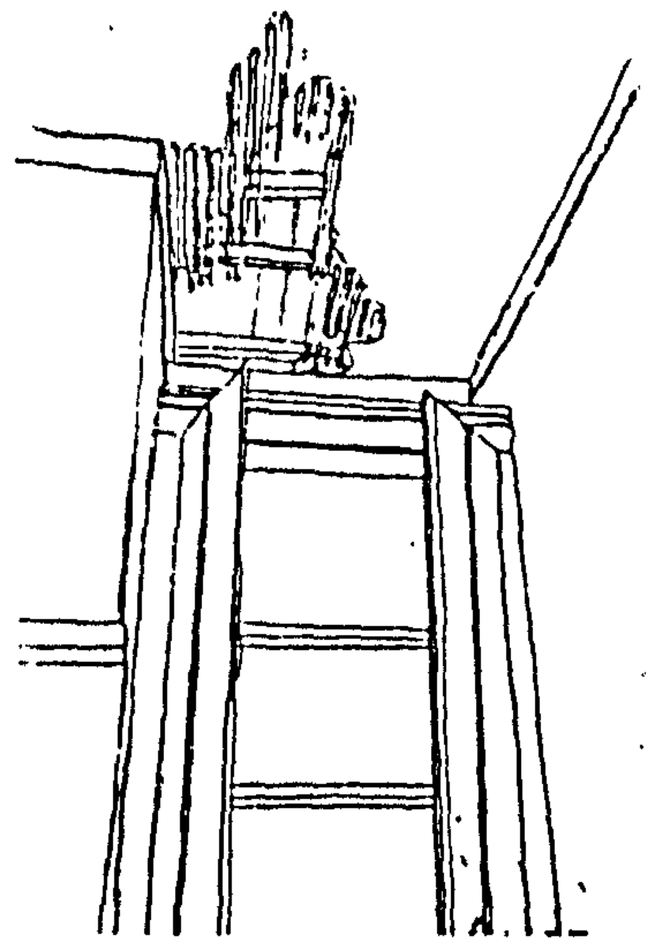


Fig.3.109-Example of plaster ceiling 102, Prata Street

3.8 Windows, doors and cupboards

The doors in the Pombaline rentable building were basically divided into two types, ledged and battened, and panelled. The ledged and battened doors consisted of a series of vertical battens, which were tongued and grooved, with the whole being held firmly together by three horizontal ledges, (Fig.3.110). These doors, which though solid, were more rudimentary in construction, were used as inner doors on the upper floors, for kitchen cupboards and often for ground floor doors. In the latter case, the battens and ledges became very thick. There are interesting examples of this type of door, where one of the batten sections acted as a window for a shop or workshop; the door would be installed in the entrance stairway to the homes (Fig.3.111).

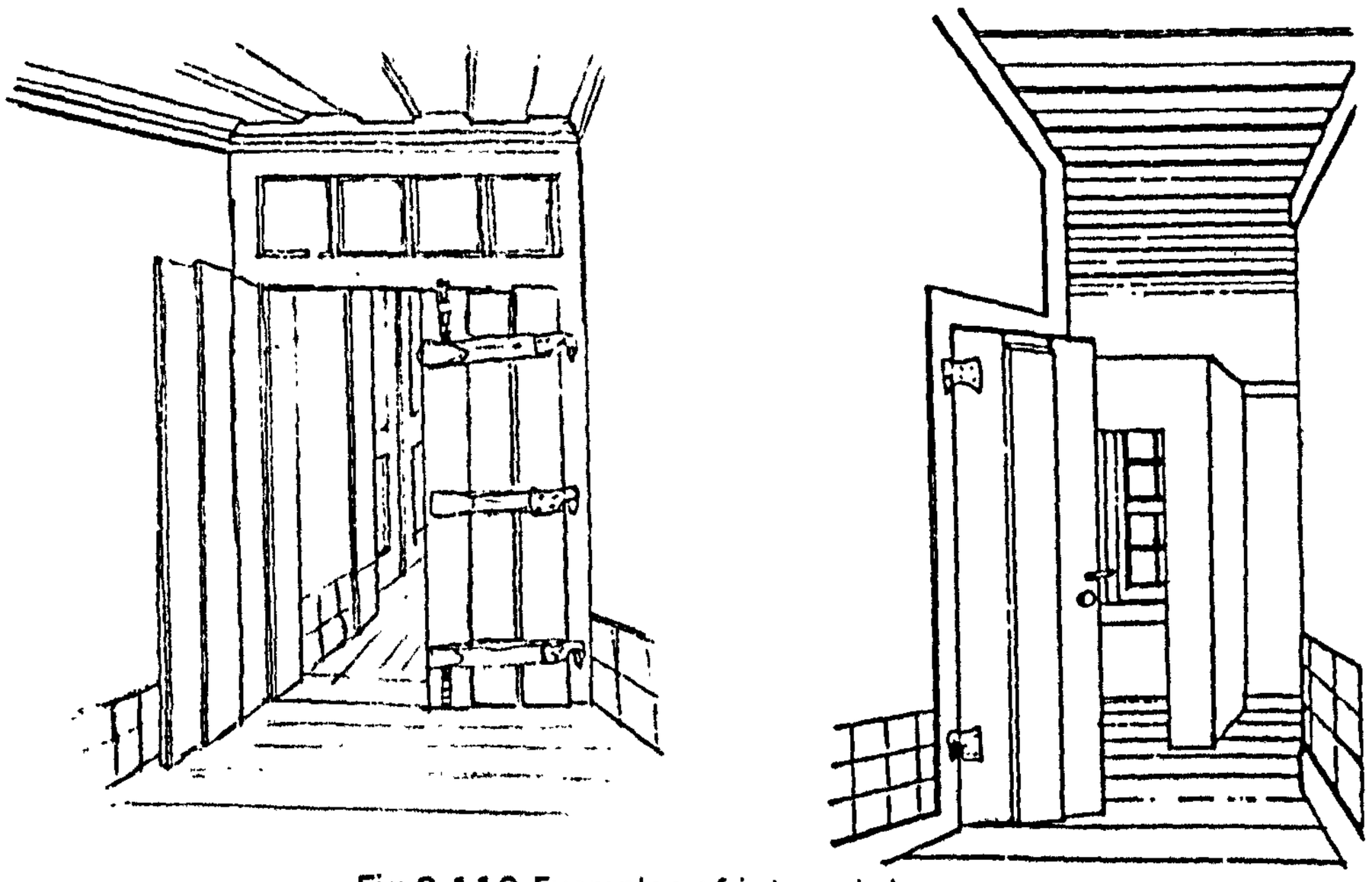


Fig.3.110-Examples of internal doors

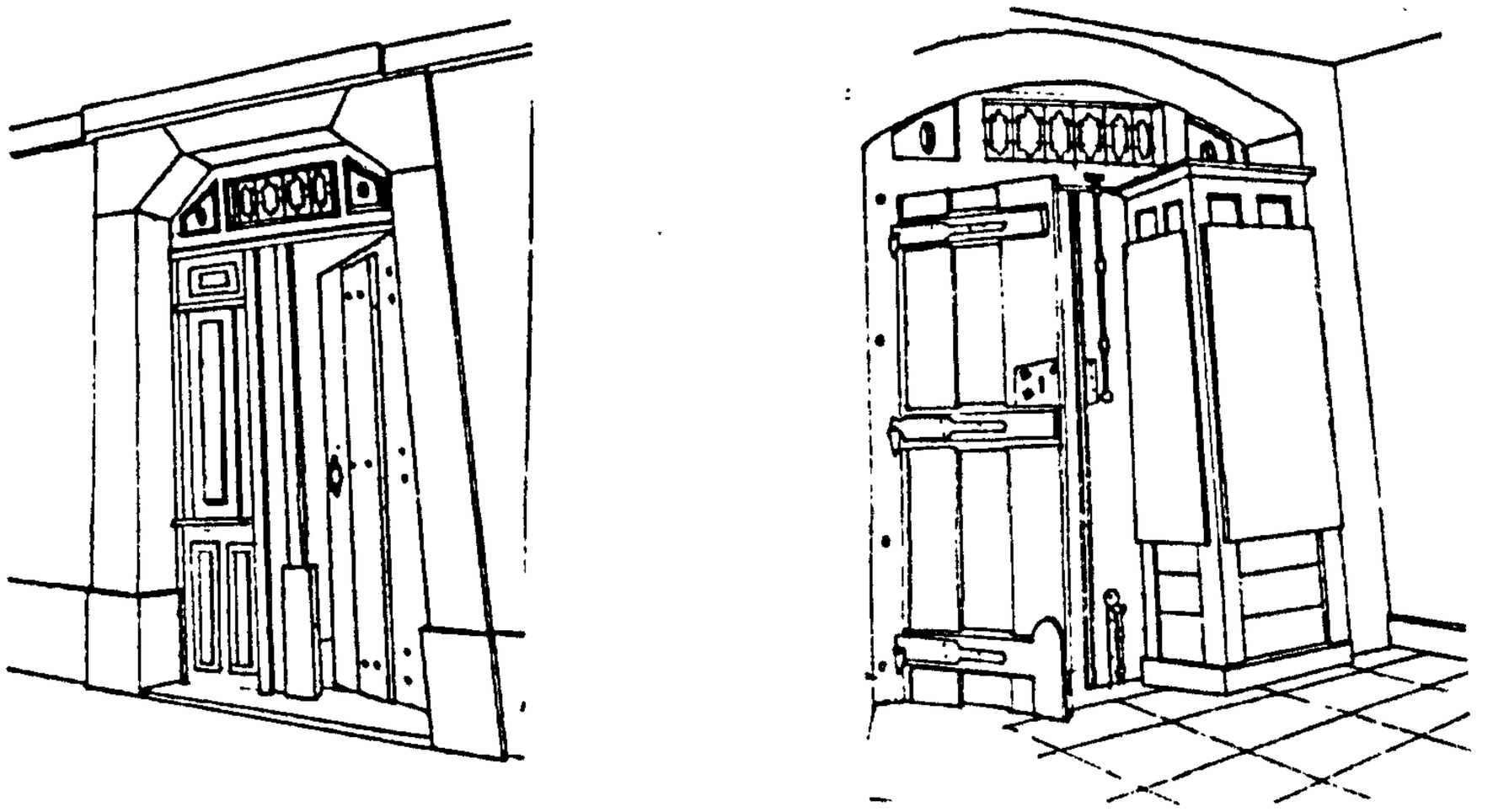


Fig.3.111-Examples of external doors (building M)

The panelled doors consisting of stiles, rails and sometimes muntins enclosing panels. Two types of panelled doors are found: a more rudimentary type where the panels are rebated and lapped to the stiles, rails and muntins (Fig.3.112), and a more sophisticated, tongued and grooved type, similar to those found in Britain from this period (Fig.3.113) with one or more panels (Fig.3.114). These were more careful and elaborate in construction and normally had a glass fanlight or an iron grille above them. They were normally used for entrance doors.

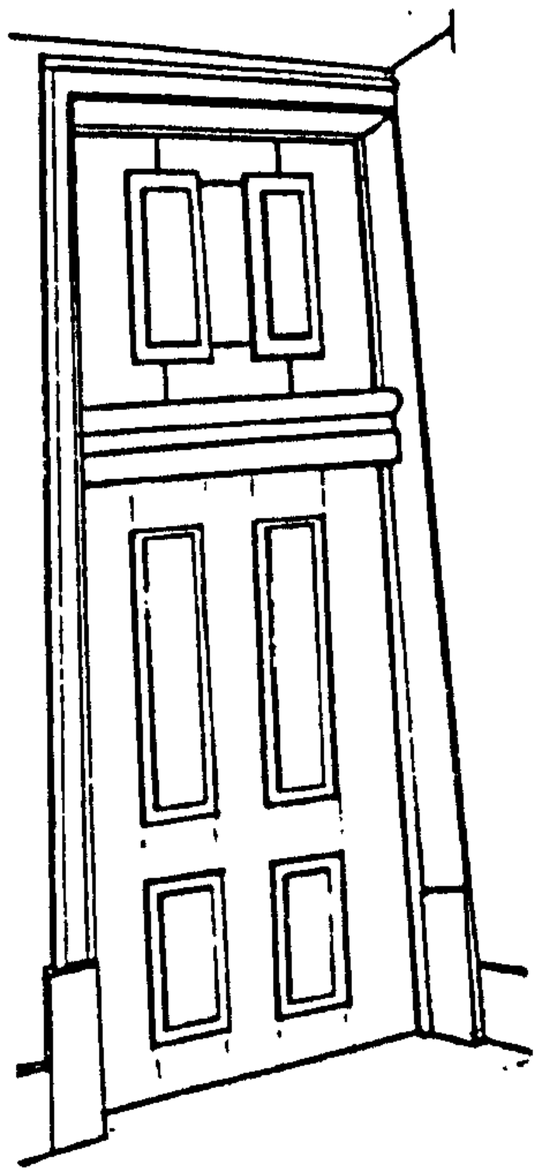


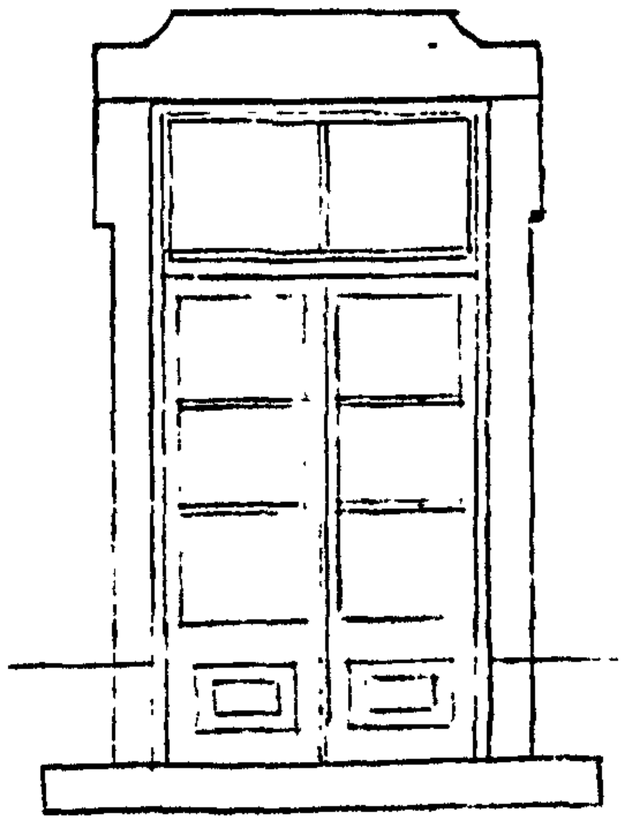
Fig.3.112-Example of a door with salient panel, 39, Fanqueiros Street

Fig.3.113-Example of door with no salient panel (building L)

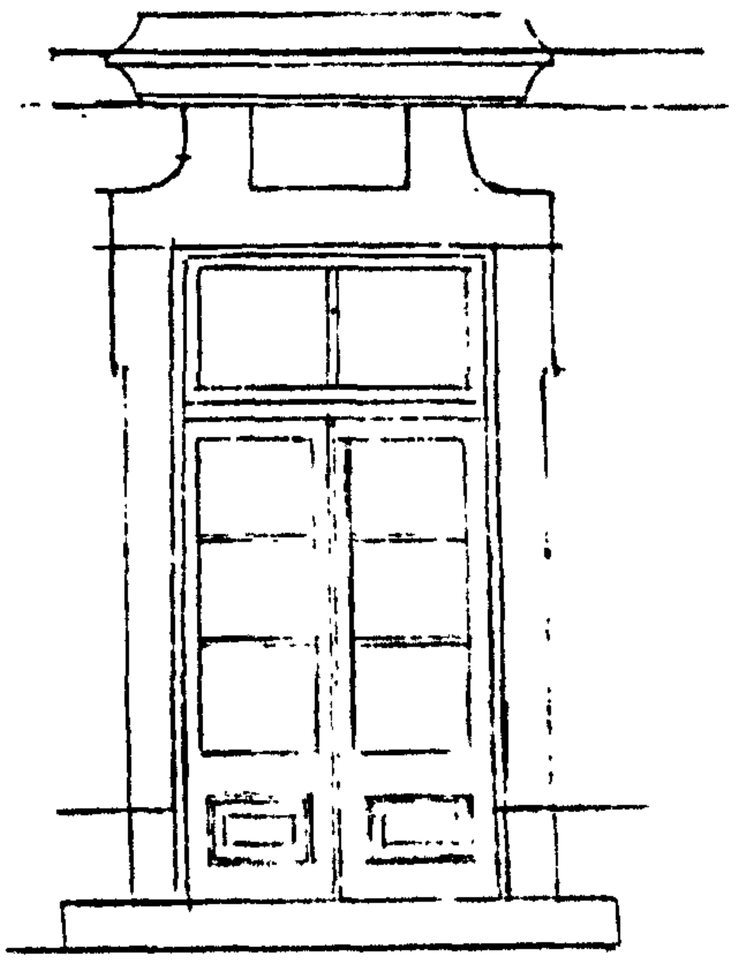
Fig.3.114-Example of a door with more than one panel, 39, Fanqueiros Street

There were also two distinct types of windows, french windows and sash windows. The French windows, seen on the first floor in the more important streets and squares were rebated casement windows (with central meeting stiles) with larger panes than the windows of the higher floors, (Fig.3.115). The lower part of the window up to height of 0,60 m consisted of a wood panel.

The sash windows, seen on the higher floors and on the façade of the internal courtyard, have smaller panes, (Fig.3.116). They had two sashes, an outer one fixed to the upper part of the frame and a lower vertical sliding one. Both window types had internal shutters as protection against light and cold.



Main streets



Rossio and Arsenal Street

Fig.3.115-French window

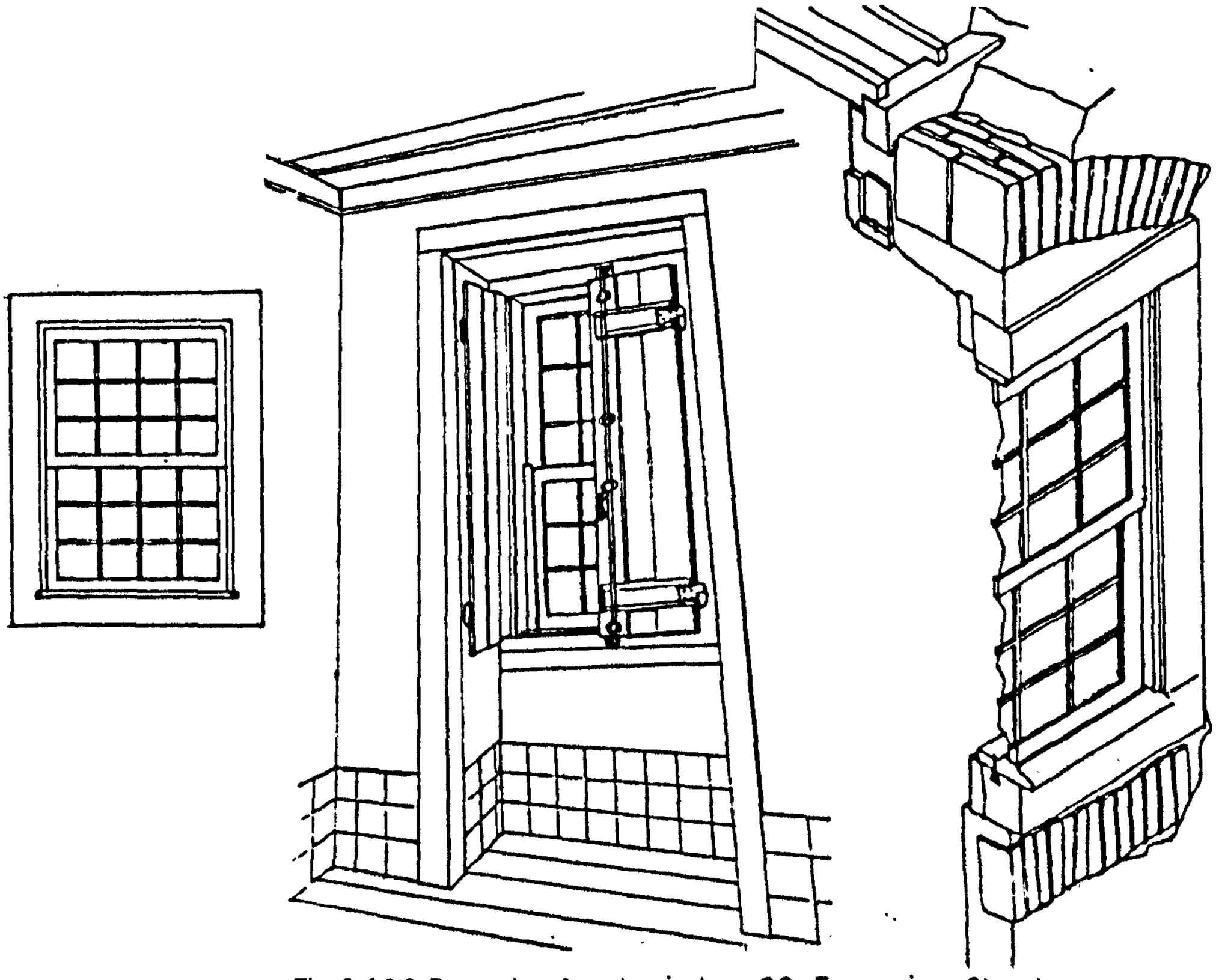


Fig.3.116-Example of sash window, 39, Fanqueiros Street

The cupboards are of two types, those on the landings (Fig.3.117), of which there are few examples and those inside the flats in the kitchen, that exist in all buildings, (building L) (Fig.3.118).

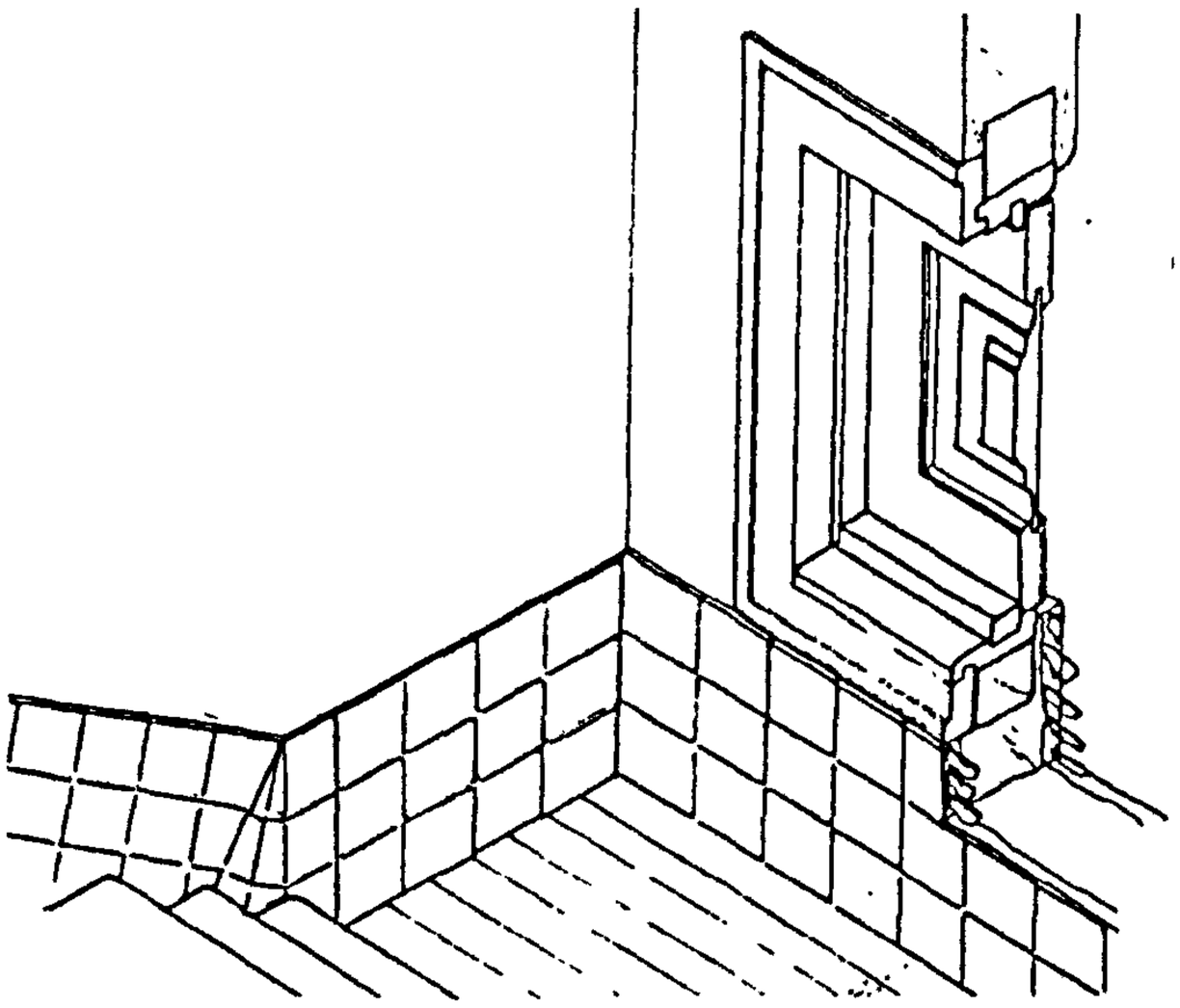


Fig.3.117-Construction detail of cupboard

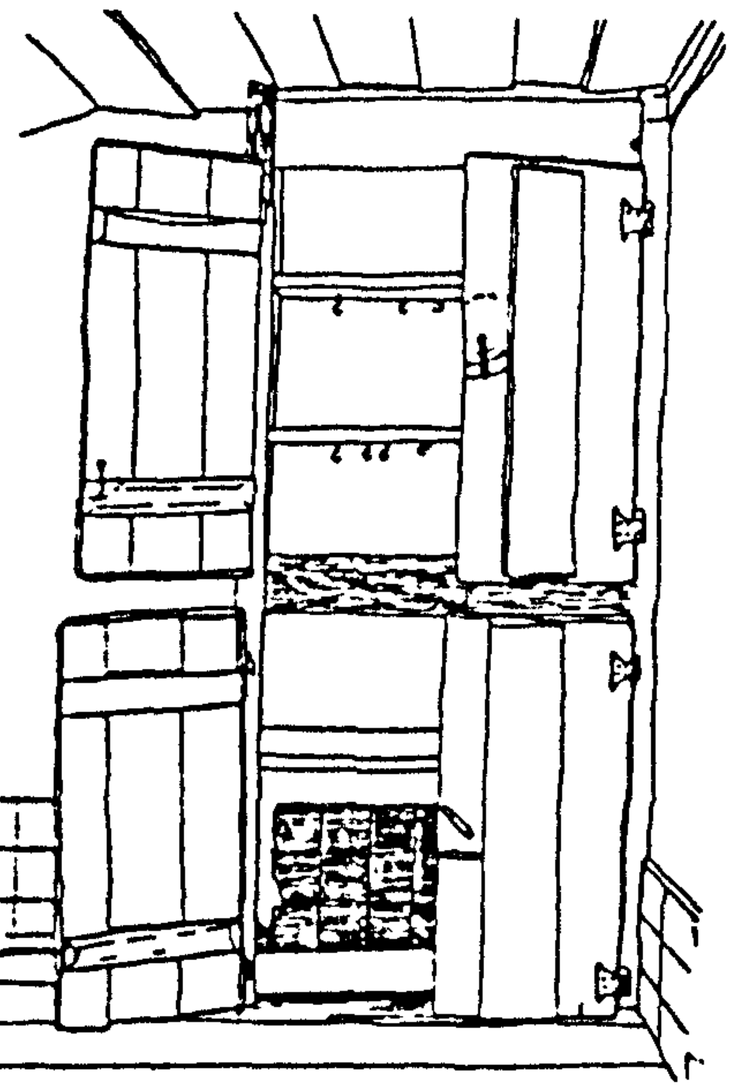


Fig.3.118-Example of cupboard in the kitchen

The hinges, three for each section, were simply made and were popularly known as "rudders without tillers". The handles on the inner doors were of the *"moleta"* type or round, and were connected to a small latch. The doors on the ground level, the entrance to the flats, had more elaborate handles either in iron or brass. In the double doors, the less used sides had barrel bolts, on the upper and lower parts, which fitted into staples that were fixed to the frames. The doors of the various flats which opened onto the stairs, had rudimentary latches operated by keys, only from the outside, (Fig.3.119 and 3.120). They also had openings with protective grilles to look through to the outside. To close the windows, espagnolette bolts were filled.

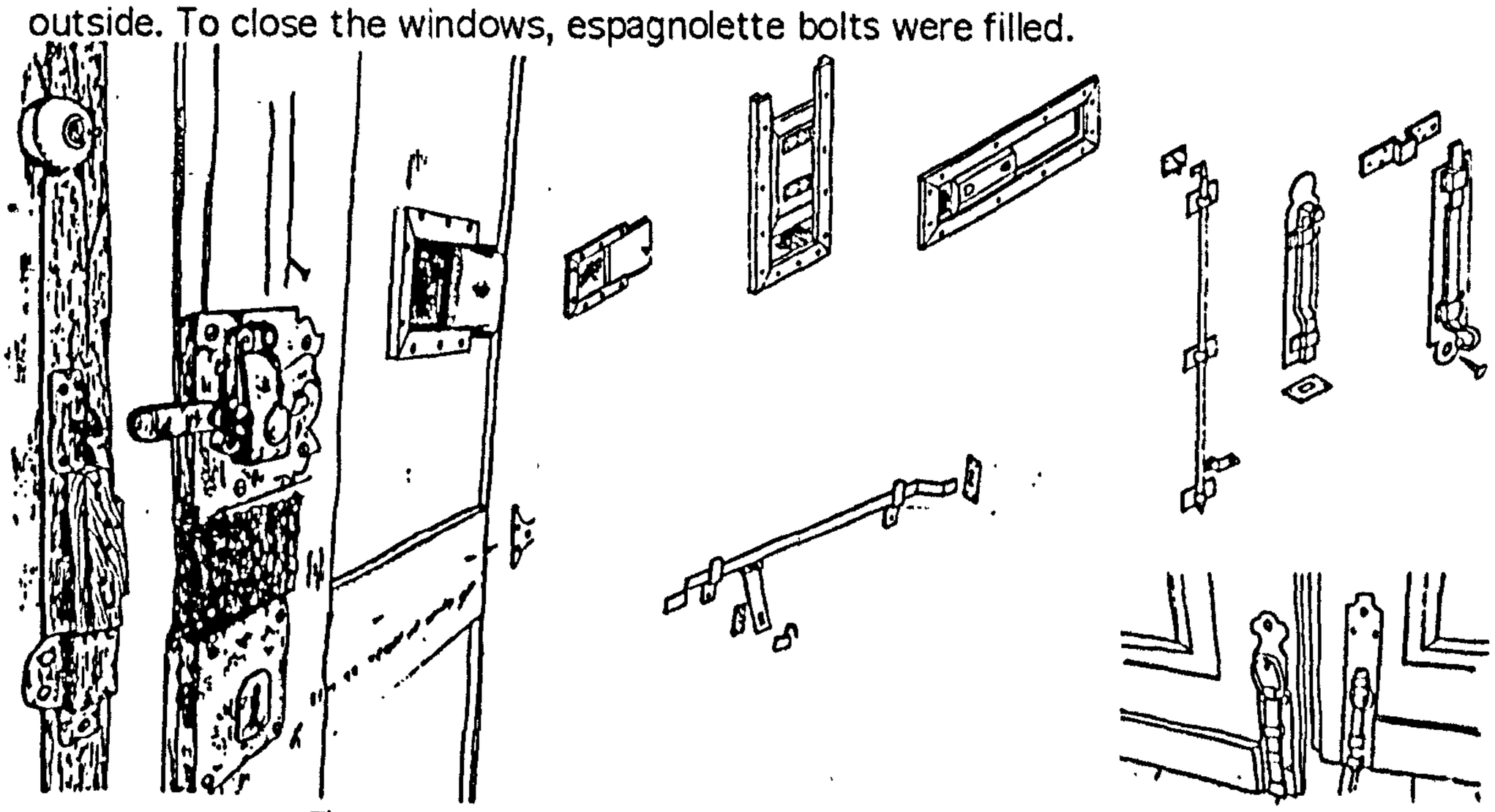


Fig.3.119-Examples of ironmongery, (building L)

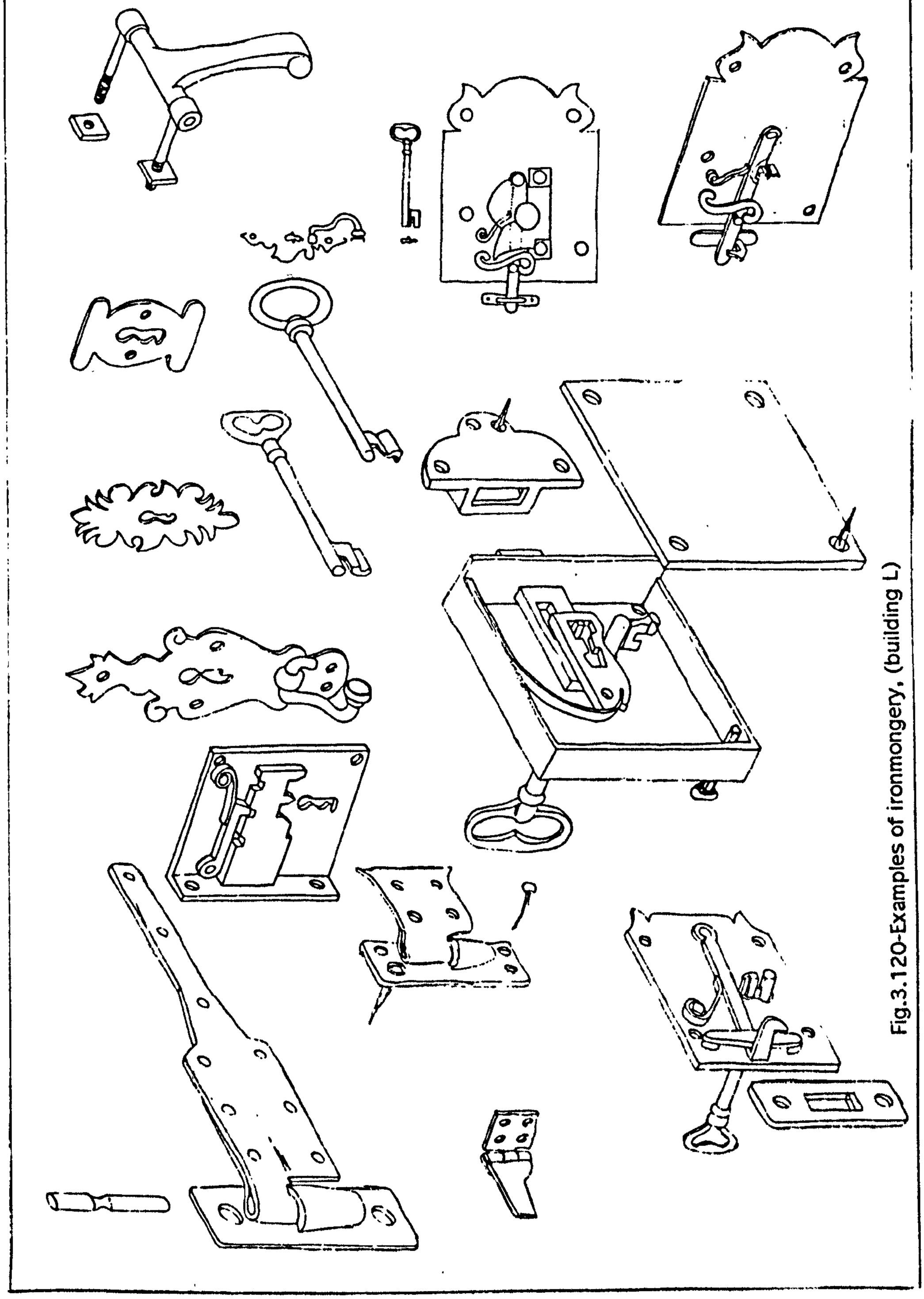


Fig.3.120-Examples of ironmongery. (building L)

3.9 The fireplace and chimney.

The fireplaces that were in the kitchens in the flats had a dual function. As well as being used for cooking, they also provided heating in winter, (Fig.3.121 and 3.122).

They were very basic in construction and had no decorative features. The fire was laid on top of a large flat stone and there was a space below for storing firewood (Fig.3.123 and 3.124). They had no system whatsoever for air to enter to activate combustion, which meant having to keep the windows half-open even in cold weather.

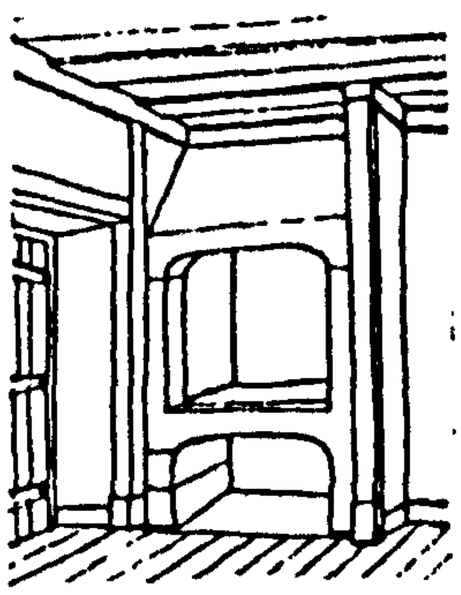


Fig.3.121-Example of a fireplace
(building J)

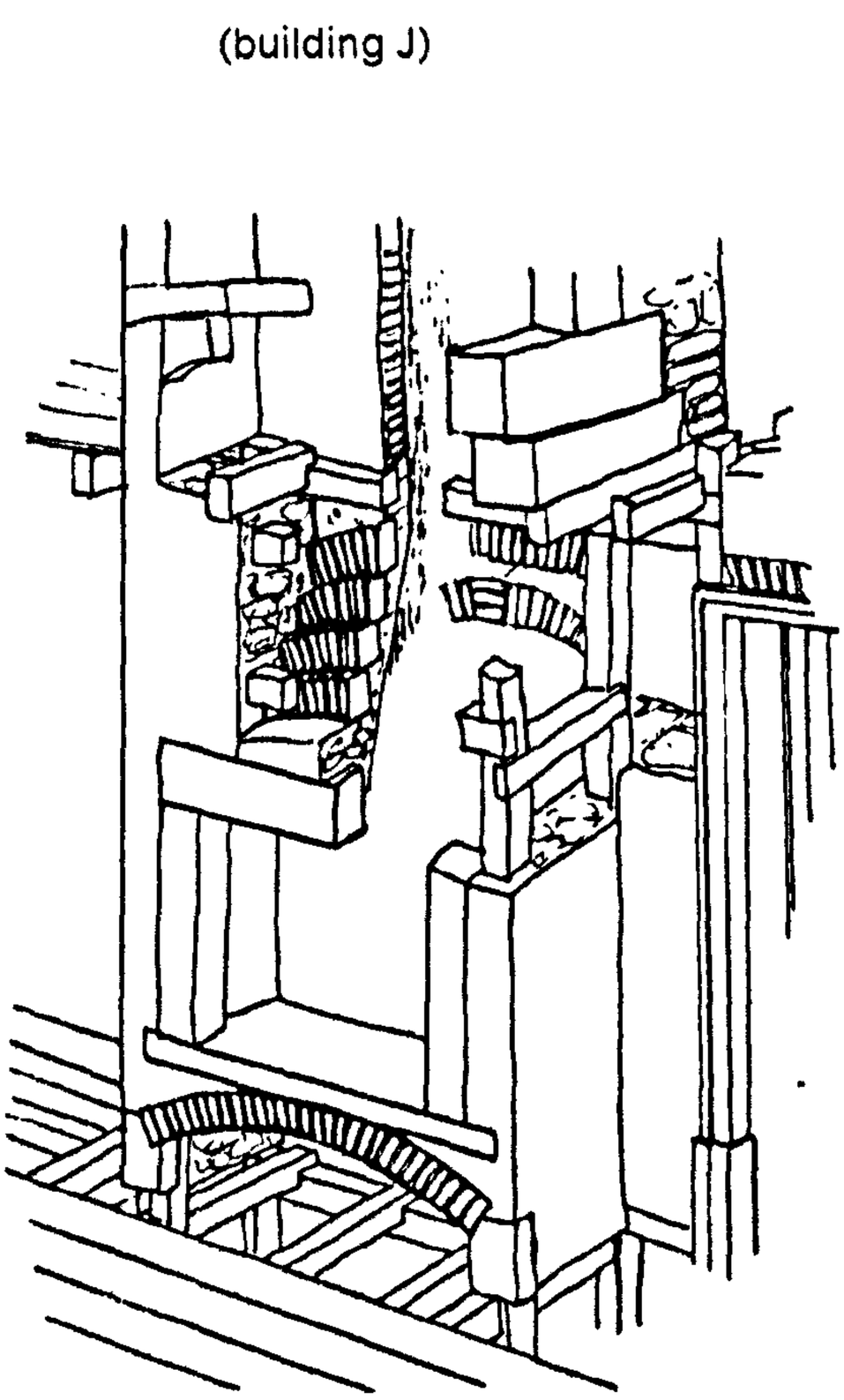


Fig.3.122-Detail construction of a chimney
(building P)

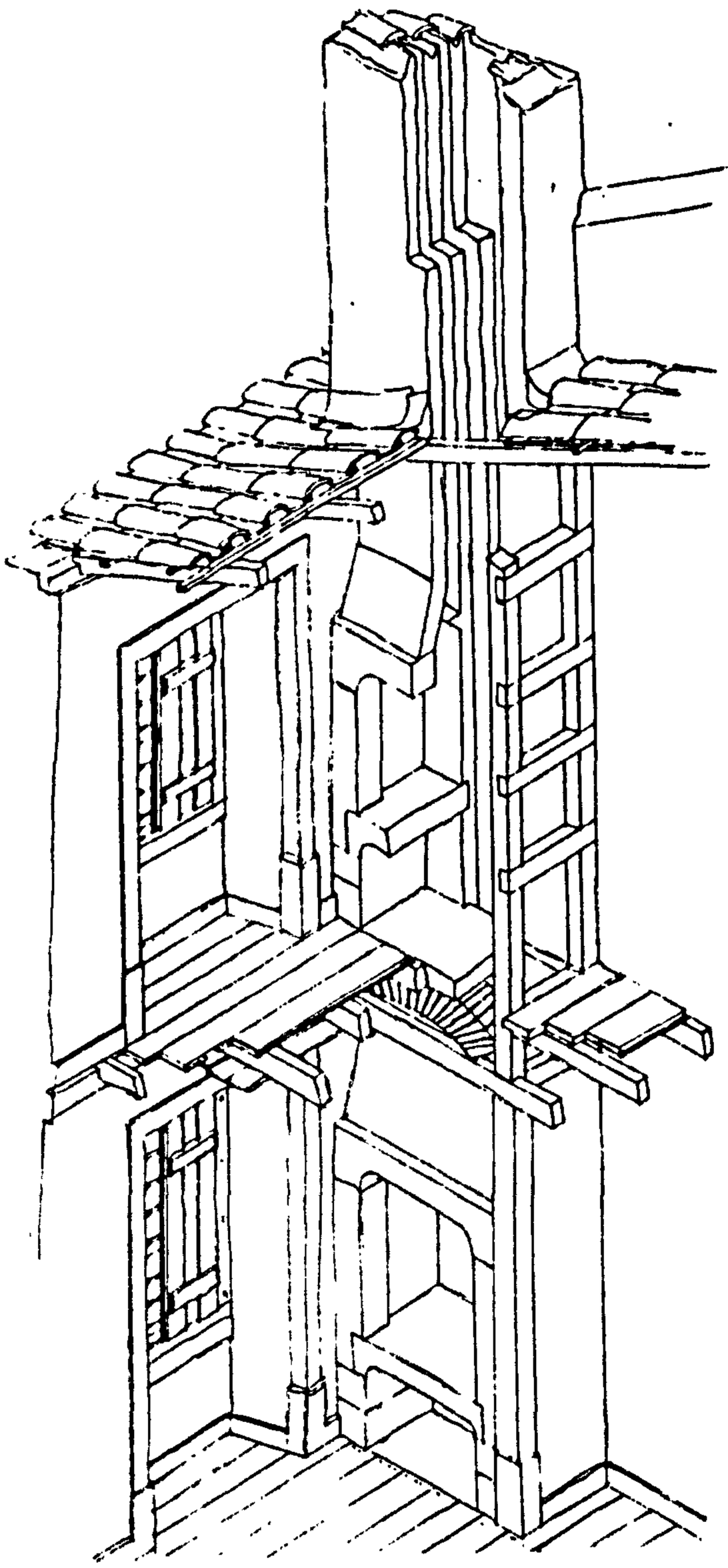


Fig.3.123-Detail construction of fireplace and chimney (building J)

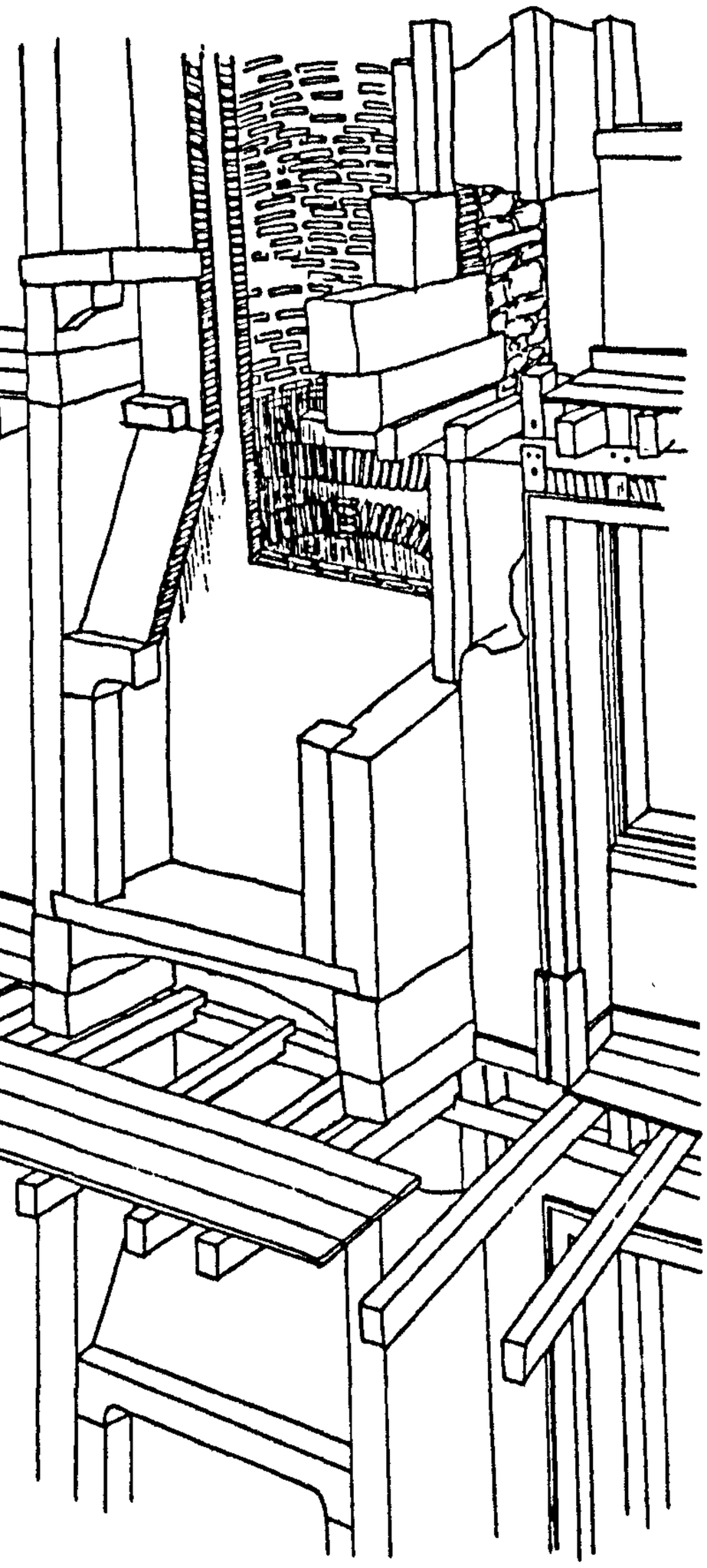


Fig.3.124-Detail construction of a chimney (building B)

Considering that the speed at which smoke is drawn out is proportional to the square of the height of the outlet, each fireplace had to have its own flue which went right to the top of the building making it very difficult for gases to return down. To increase the efficiency of the draught, the hood section of the vertical flue was made as narrow as possible and grouped together with other flues in order to prevent loss of heat, and to encourage the flue gases to rise, (Fig.3.125, 3.126 and 3.127). The tops of all the flues were covered with curved tiles to prevent rain water from entering, (Fig.3.128). The abutments of the roof to the chimneys were weathered with zinc flashings, (Fig.3.129).

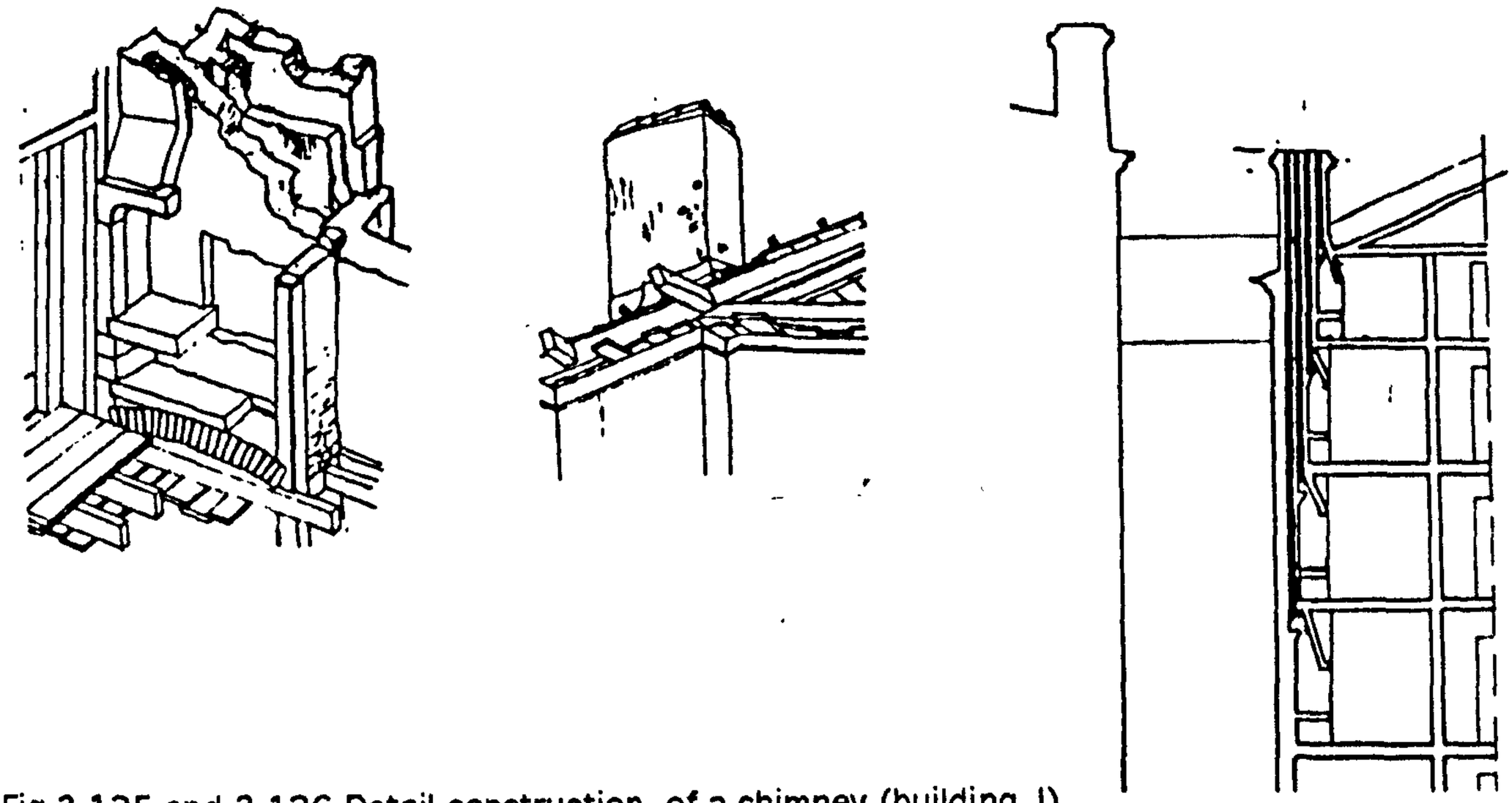


Fig.3.125 and 3.126-Detail construction of a chimney (building J)

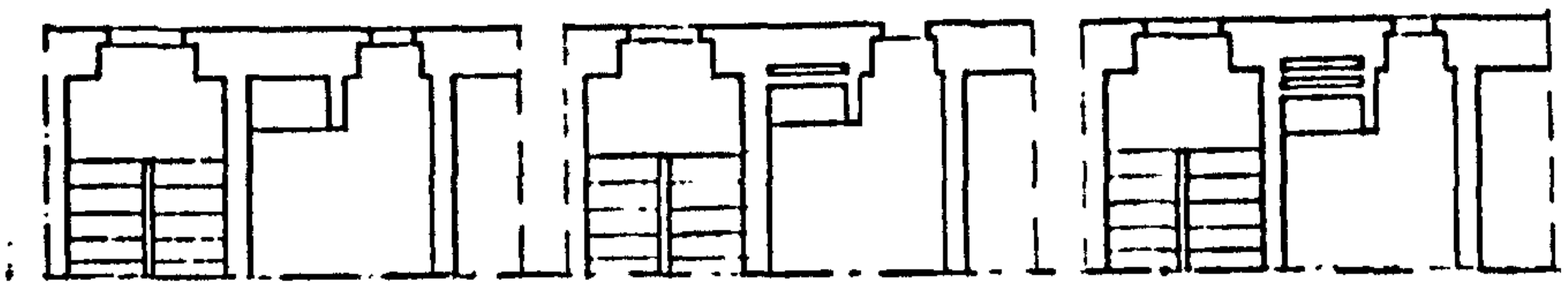


Fig.3.127-Plans of different floors, 118, Sapateiros Street

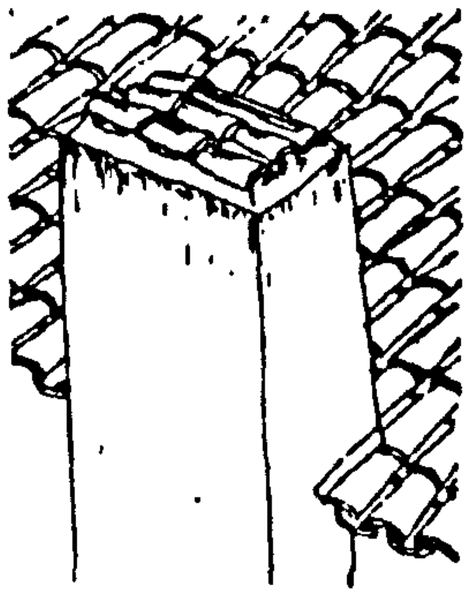
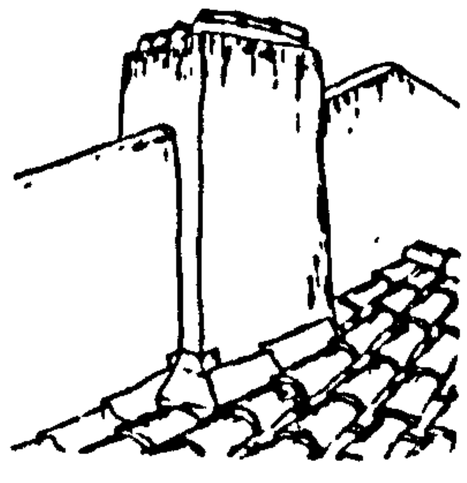


Fig.3.128-The flue outlets (building P)



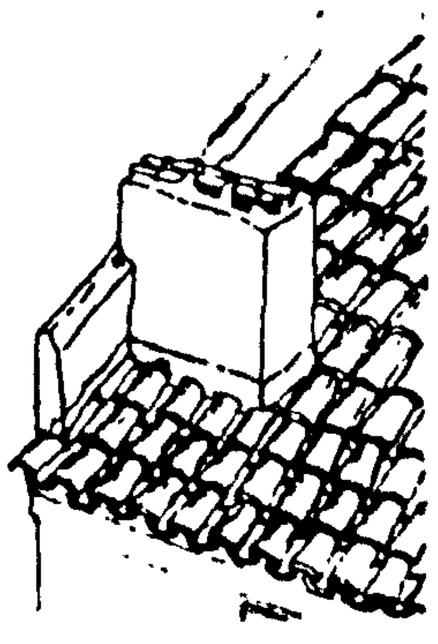
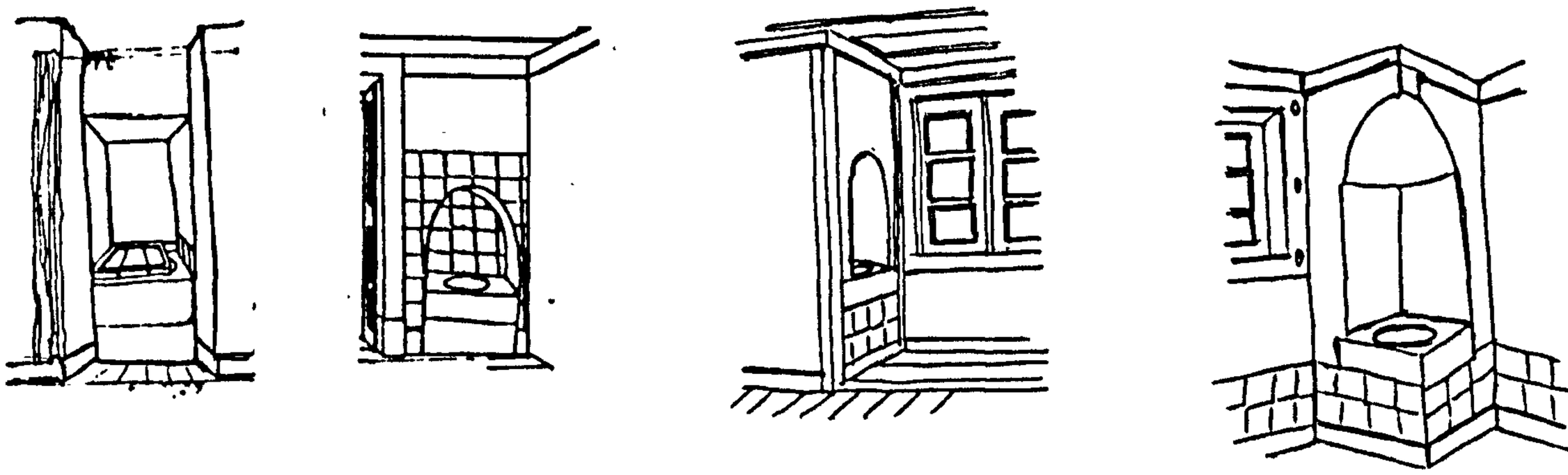


Fig.3.129-The chimneys (building A)

3.10 The drainage system.

A sink was the only waste water disposal point in the flats, (Fig.3.130). It consisted of a small square-section block of stone with a hollowed out concave surface on top, in the centre of which was an outlet. It was always situated in one of the corners of the kitchen and always on an outer wall, (Fig.3.131 and 3.132).



28, Comércio Street (building L)

Fig.3.130-Examples of sinks

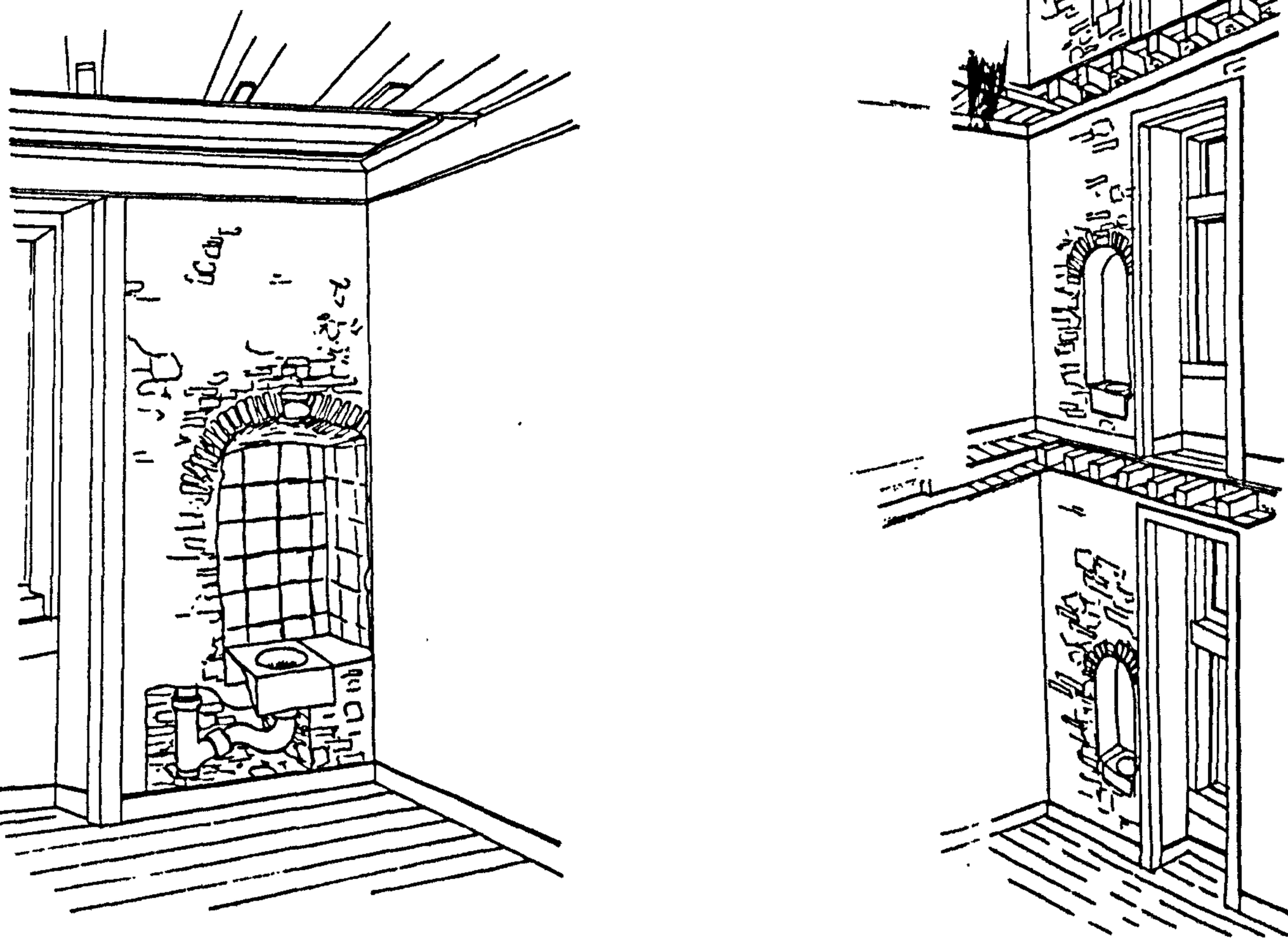


Fig.3.131 and 3.132-Details of the construction of a drainage system (building C)

Below the sink a siphon pipe came out which was connected to the building´s main drainpipe, (Fig.3.133). The soil stack was formed by a series of socketed ceramic pipes, which are very similar to the glazed stoneware ones in use today, except for the fact that the section was elliptical. In order to hide it better in the *alfugere* wall, where it extended above the roof, there was a rounded ventilation pipe made of stone about 1,20 m in height, (Fig.3.134).

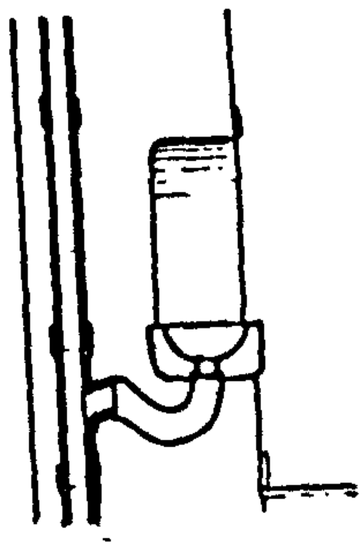


Fig.3.133-Section through a sink (building L)

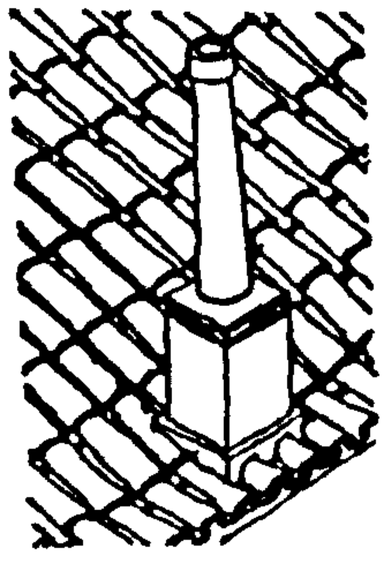


Fig.3.134-Ventilation pipe (building L)

Its lower part ended in an open stone box, from which the waste ran into a stone gutter before entering the main pipe of the *alfugere*. The fact that there was an opening in the lower part of the drainpipe made it easier to clean it as well as making the flow of waste from the vertical to horizontal easier, (Fig.3.135, 3.136 and 3.137).

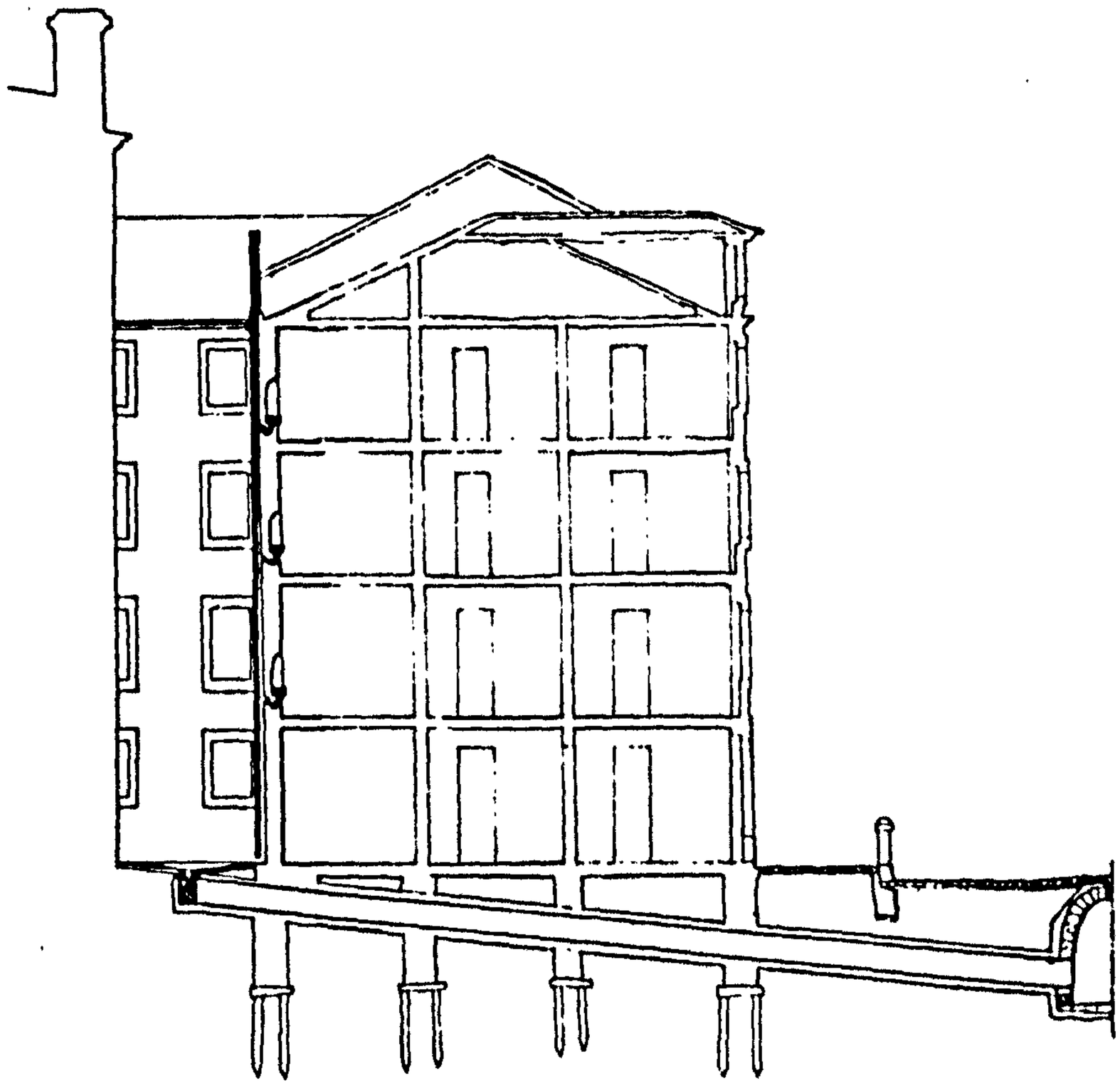


Fig.3.135-Section of the drainage system of the building (building M)

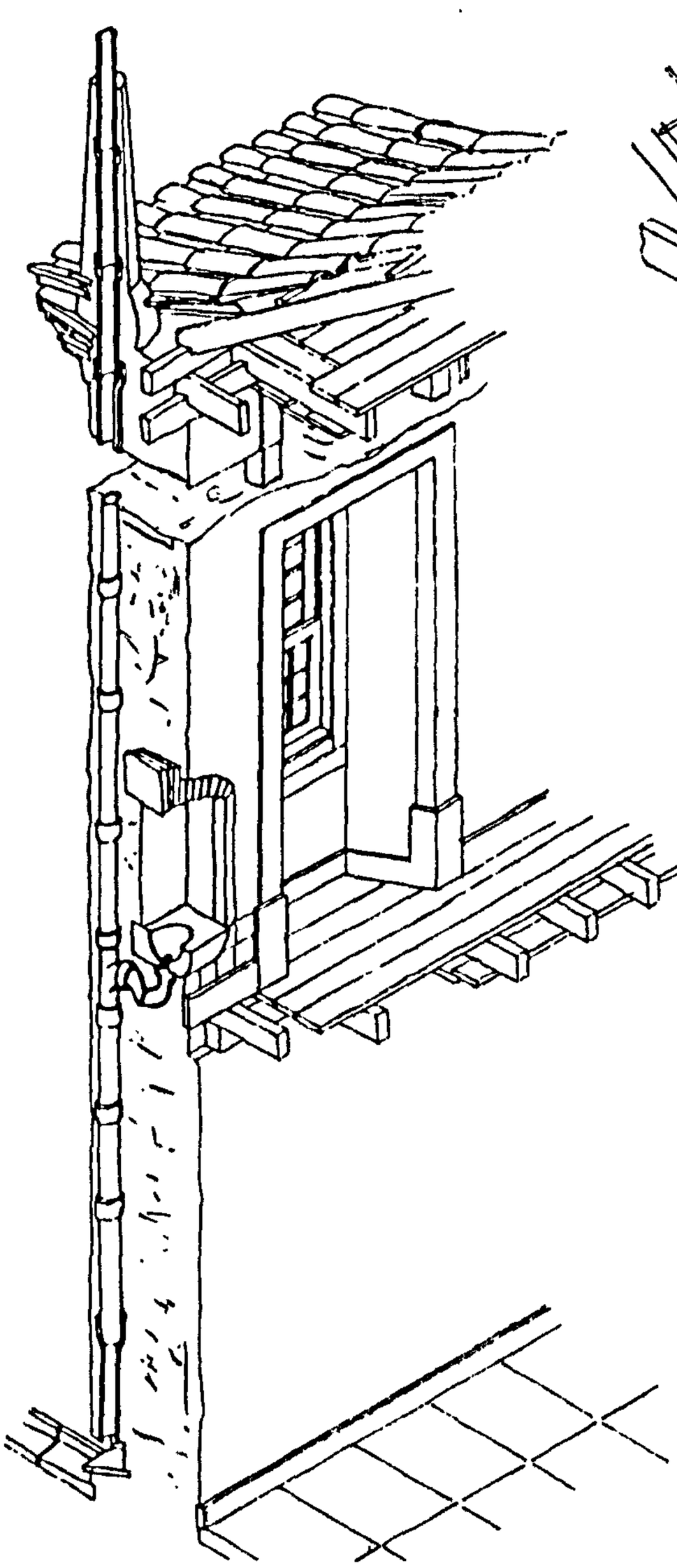


Fig.3.136-Construction detail of the drainage system of the building (building M)

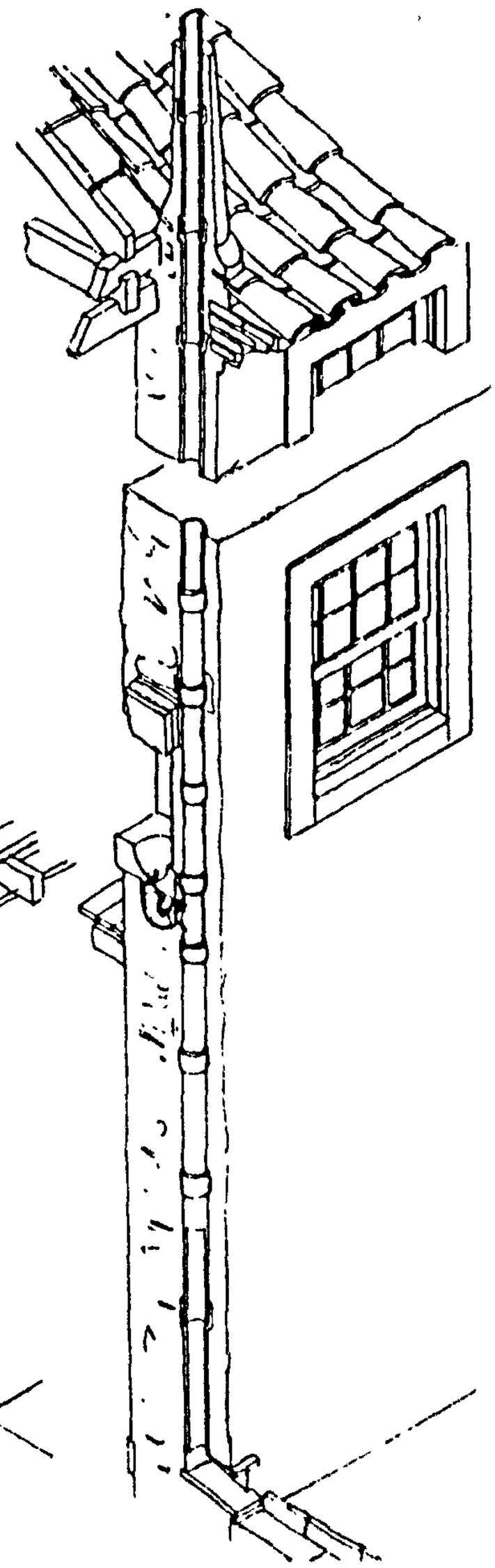


Fig.3.137-Construction detail of the drainage system of the building, outside view (building M)

3.11 Access to the flats.

A bell system was fitted to the flats to announce the arrival of visitors. This basically consisted of a wire which, when it was pulled at the entrance to the building, rang a small bell in a cage made of metal strips, which was located on the first floor landing, (Fig.3.138).

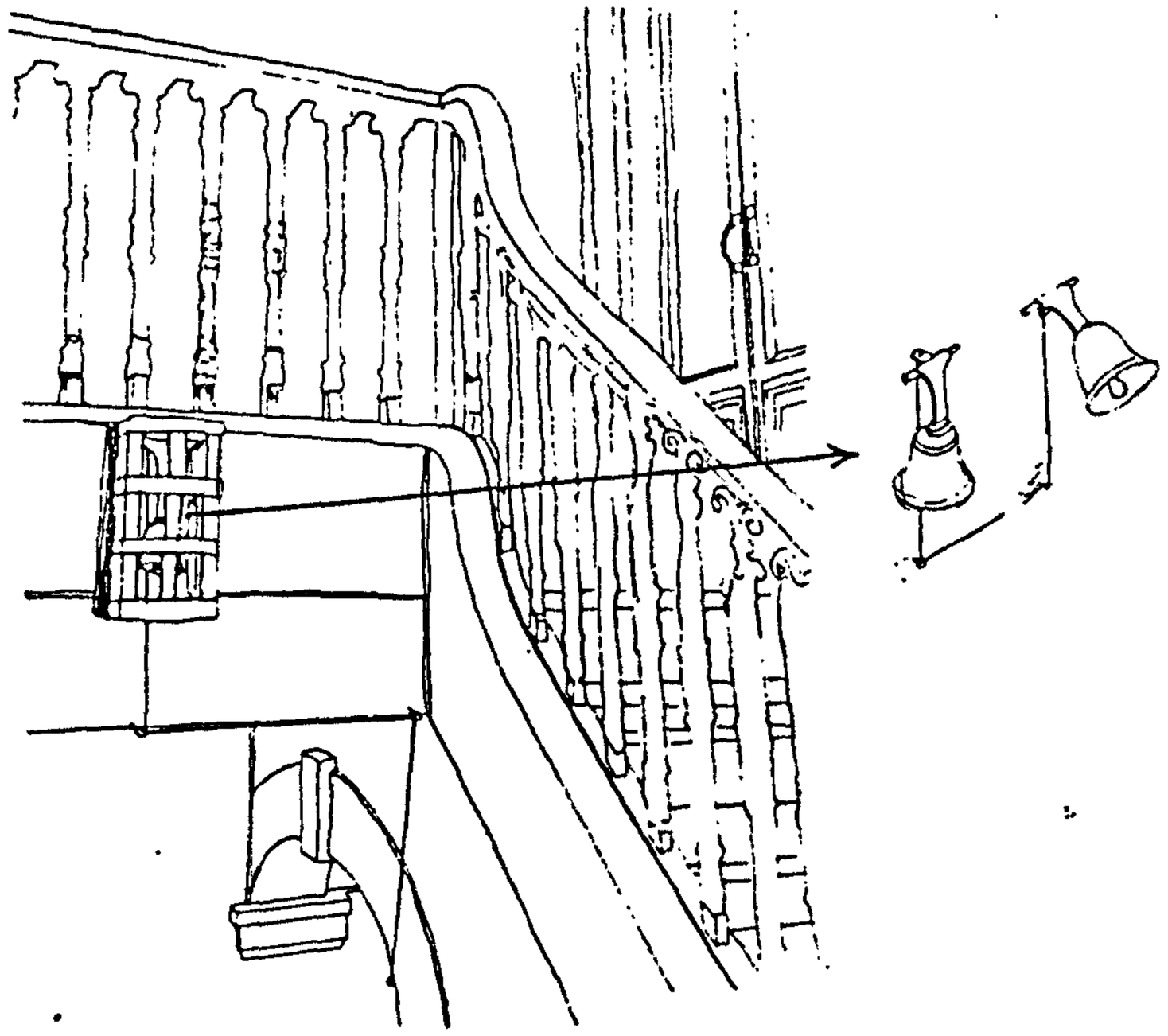


Fig.3.138-The bell system, 25, Assunção Street

The door opening device for the building which gave access to the flats consisted of a vertical iron shaft in conjunction with levers on every level which, when they were pulled, set off an articulated system which opened the front entrance door latch, (Fig.3.139).

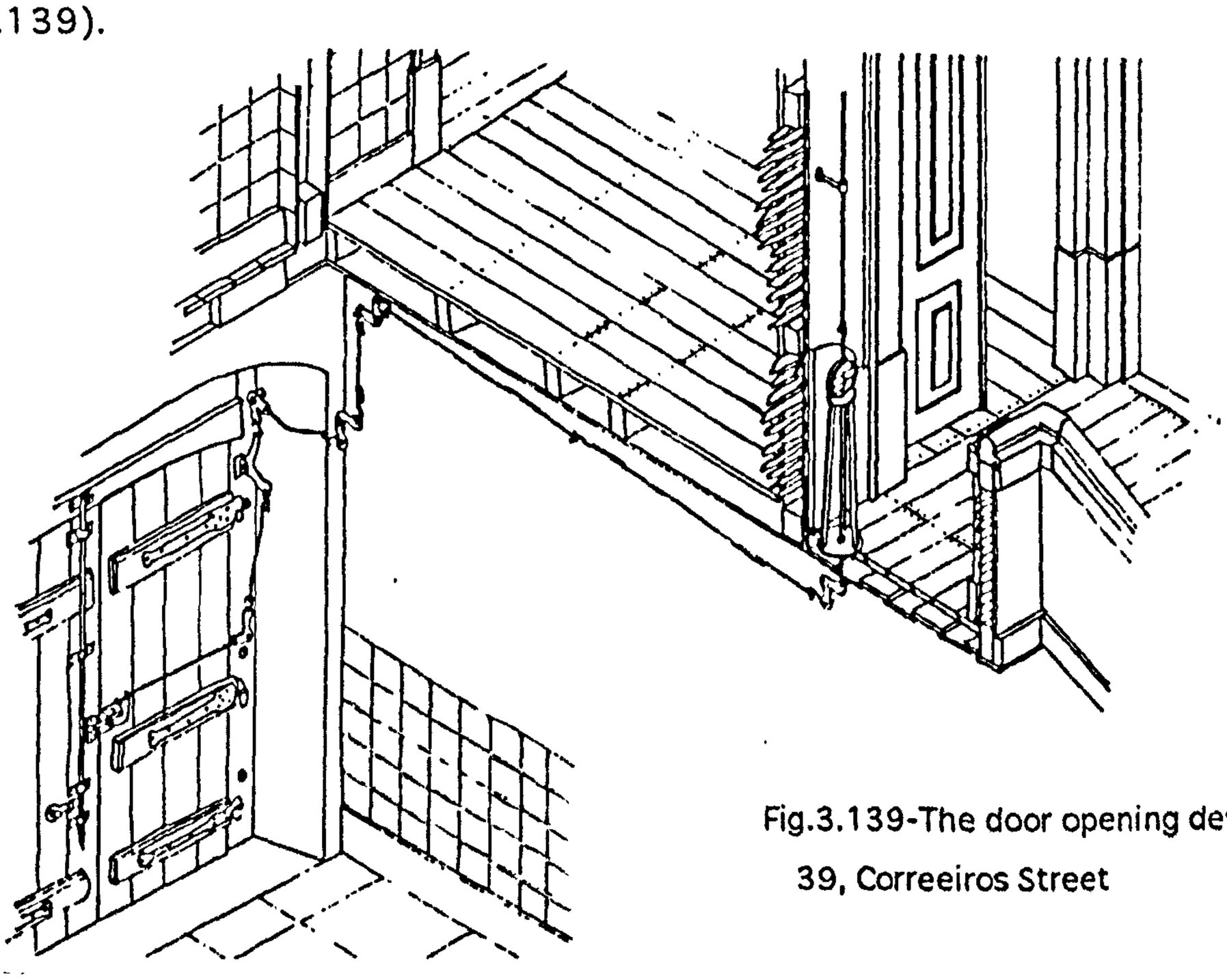


Fig.3.139-The door opening device, 39, Correeiros Street

3.12 Drawings of some of the buildings which have been partly or completely demolished.

The following figures 3.140 to 3.158, show the construction details of buildings that were either completely demolished or substantially altered see section 3.1. They form a complete record of the construction details of the buildings which were carefully observed and recorded during demolition.

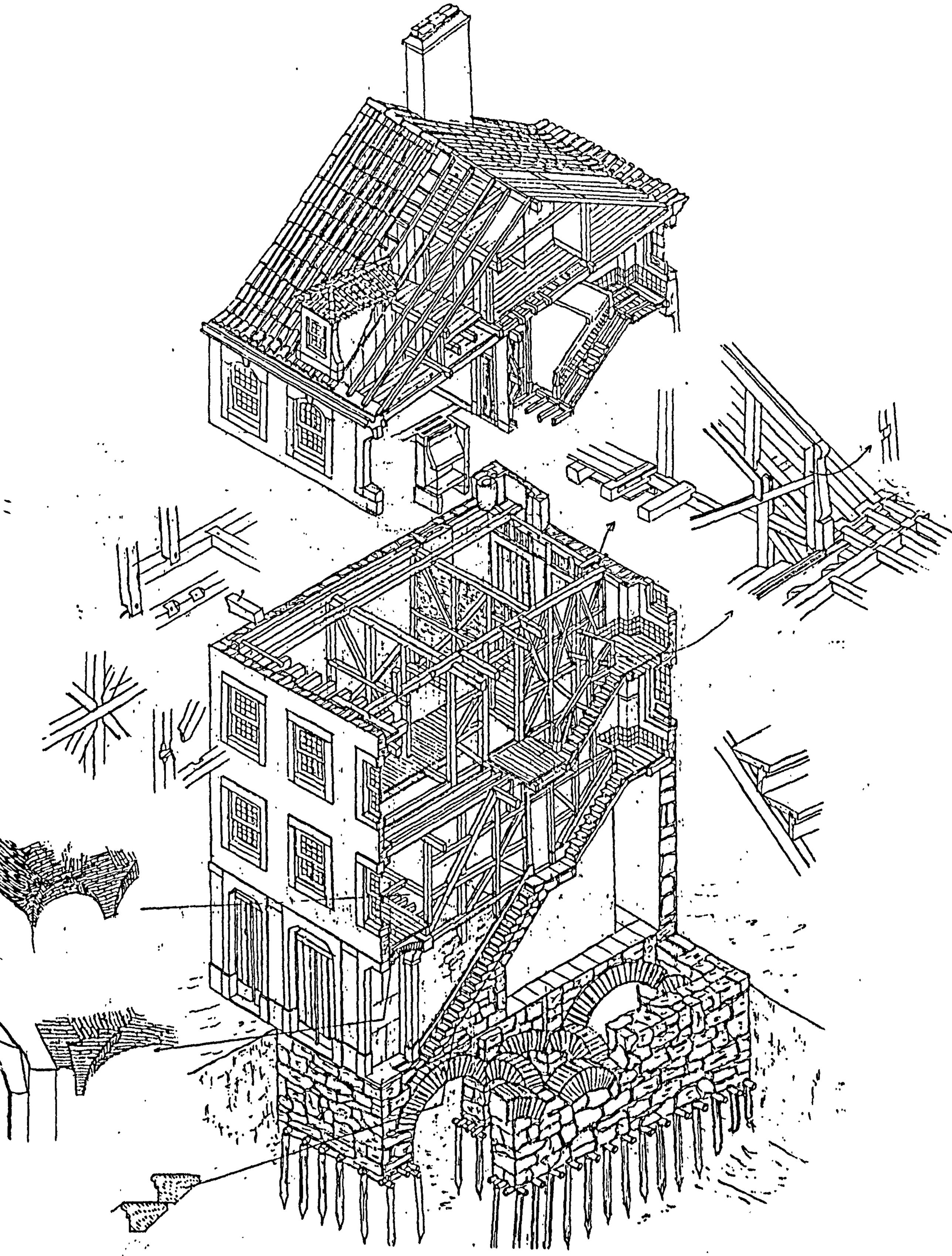


Fig.3.140-Isometric showing the construction, (building A)

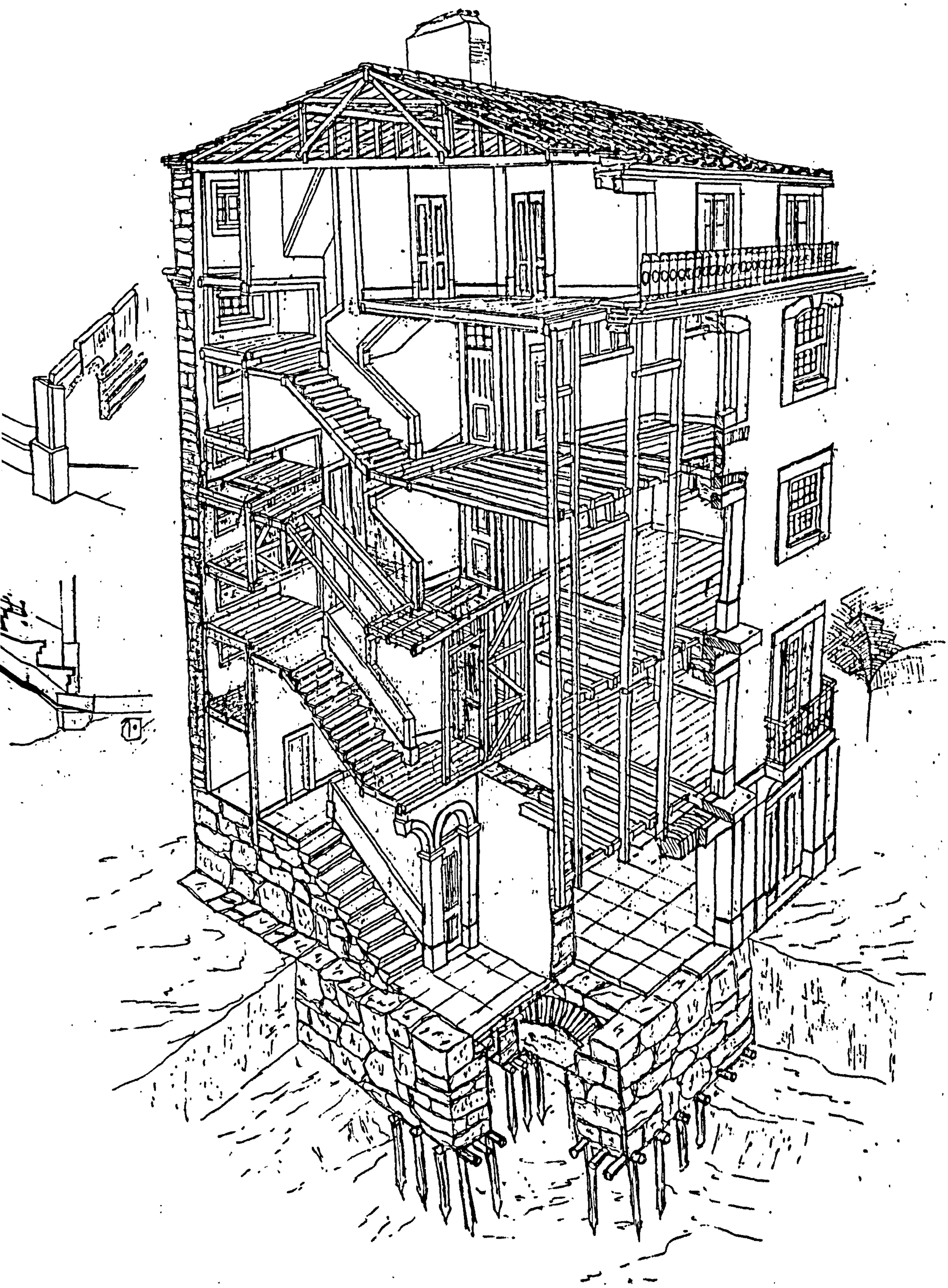


Fig.3.141-Perspective showing the construction, (building B)

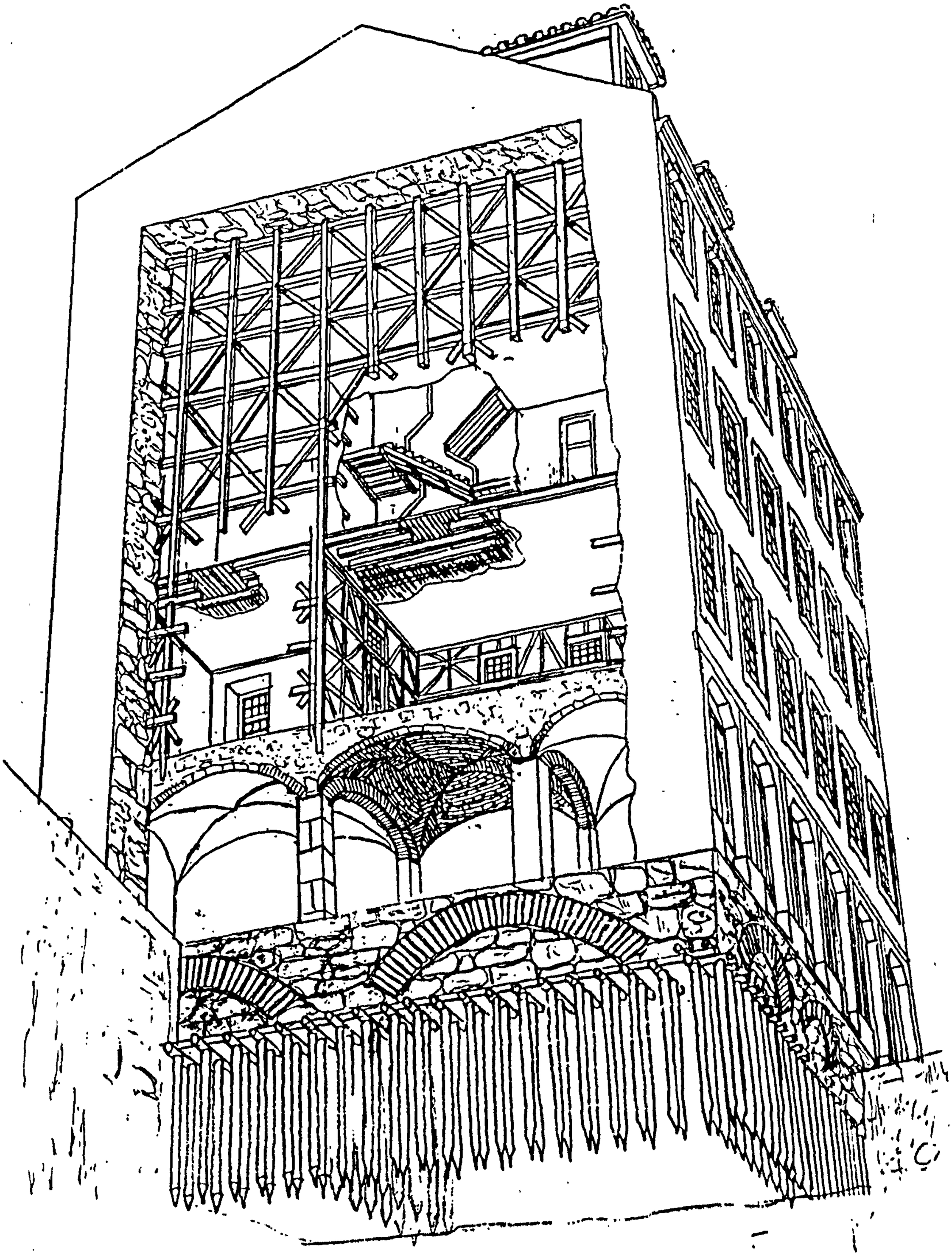


Fig.3.142-Perspective showing the construction, (building C)

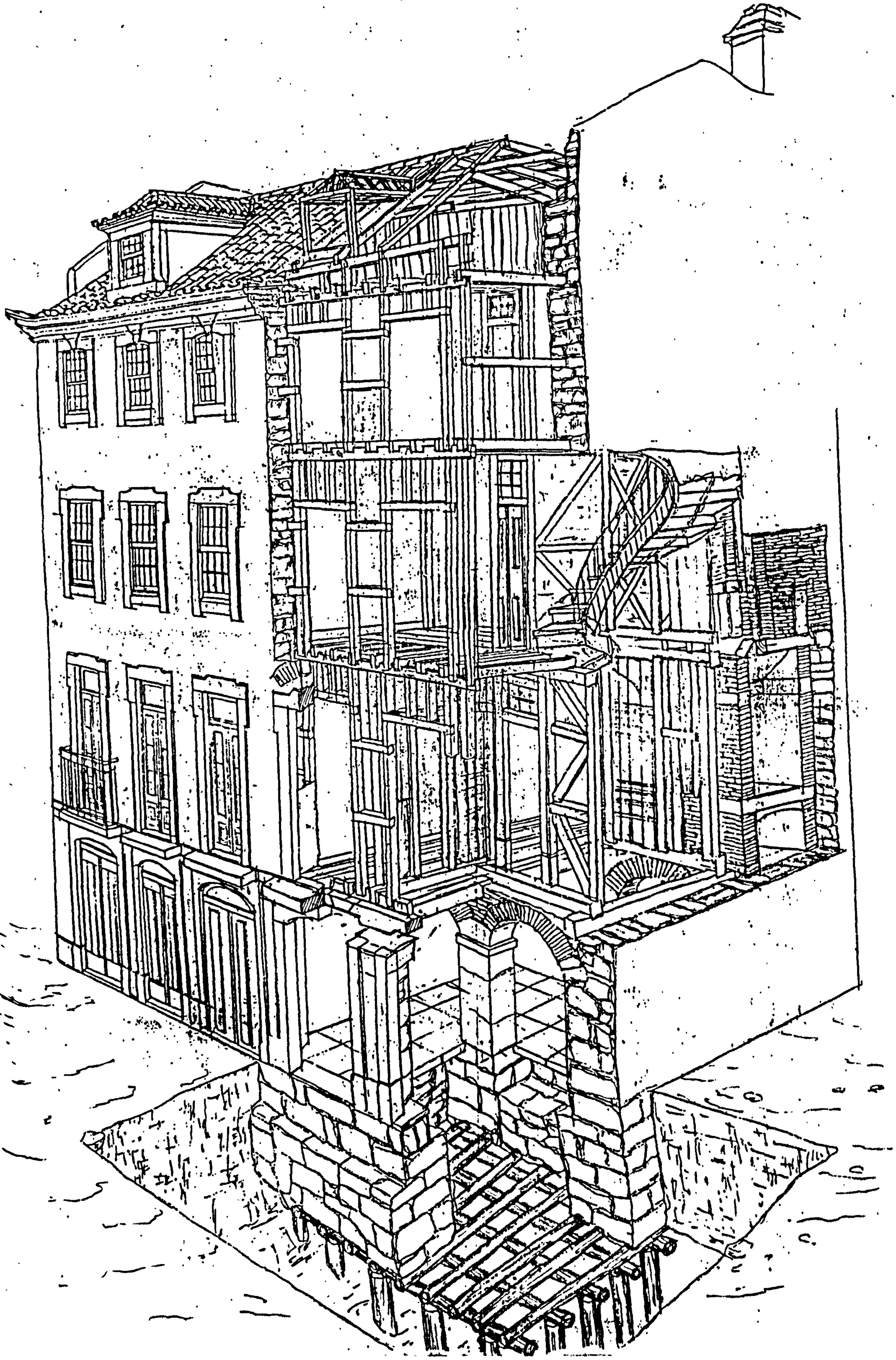


Fig.3.143-Perspective showing the construction, (building D)

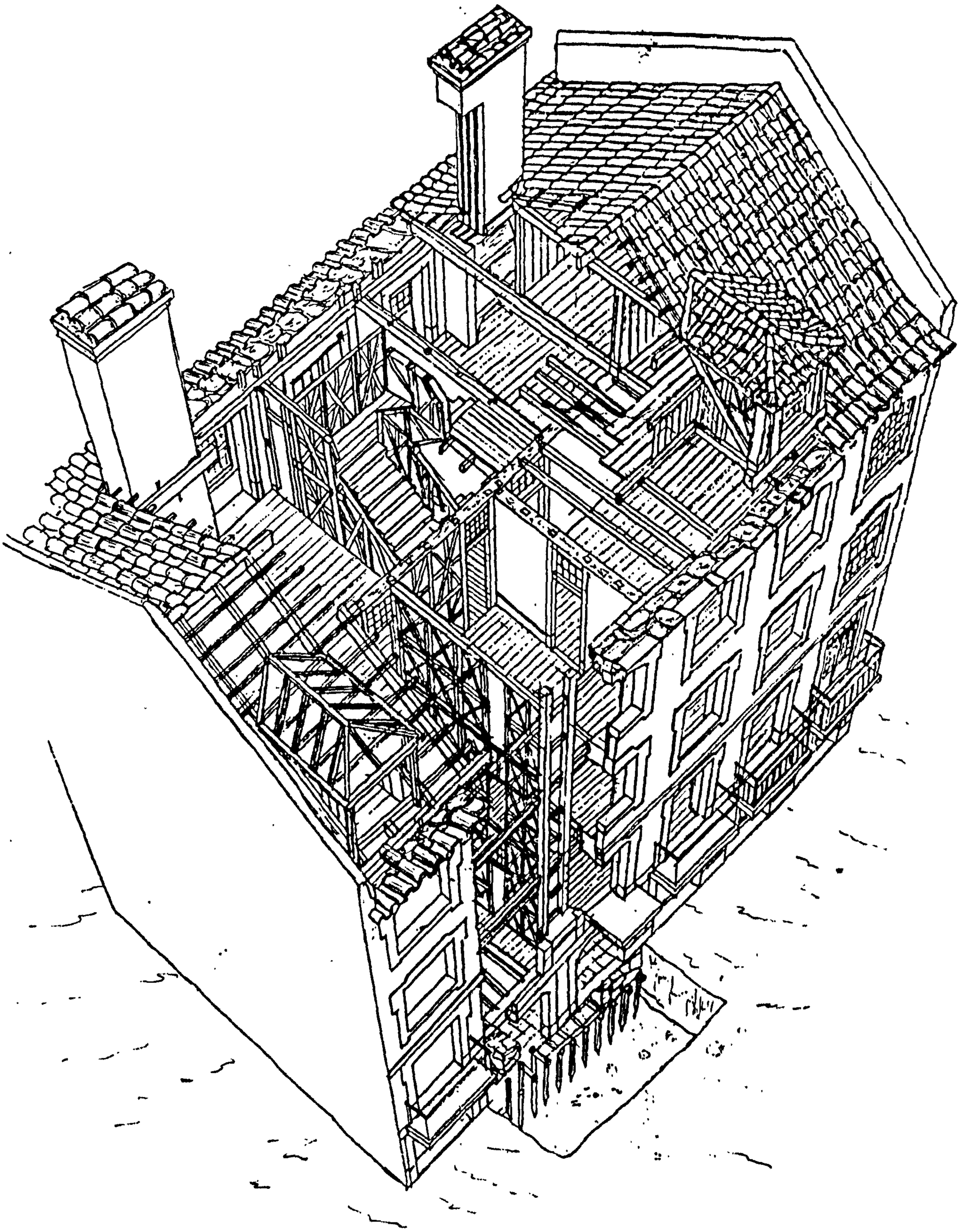


Fig.3.144-Perspective showing the construction, (building E)

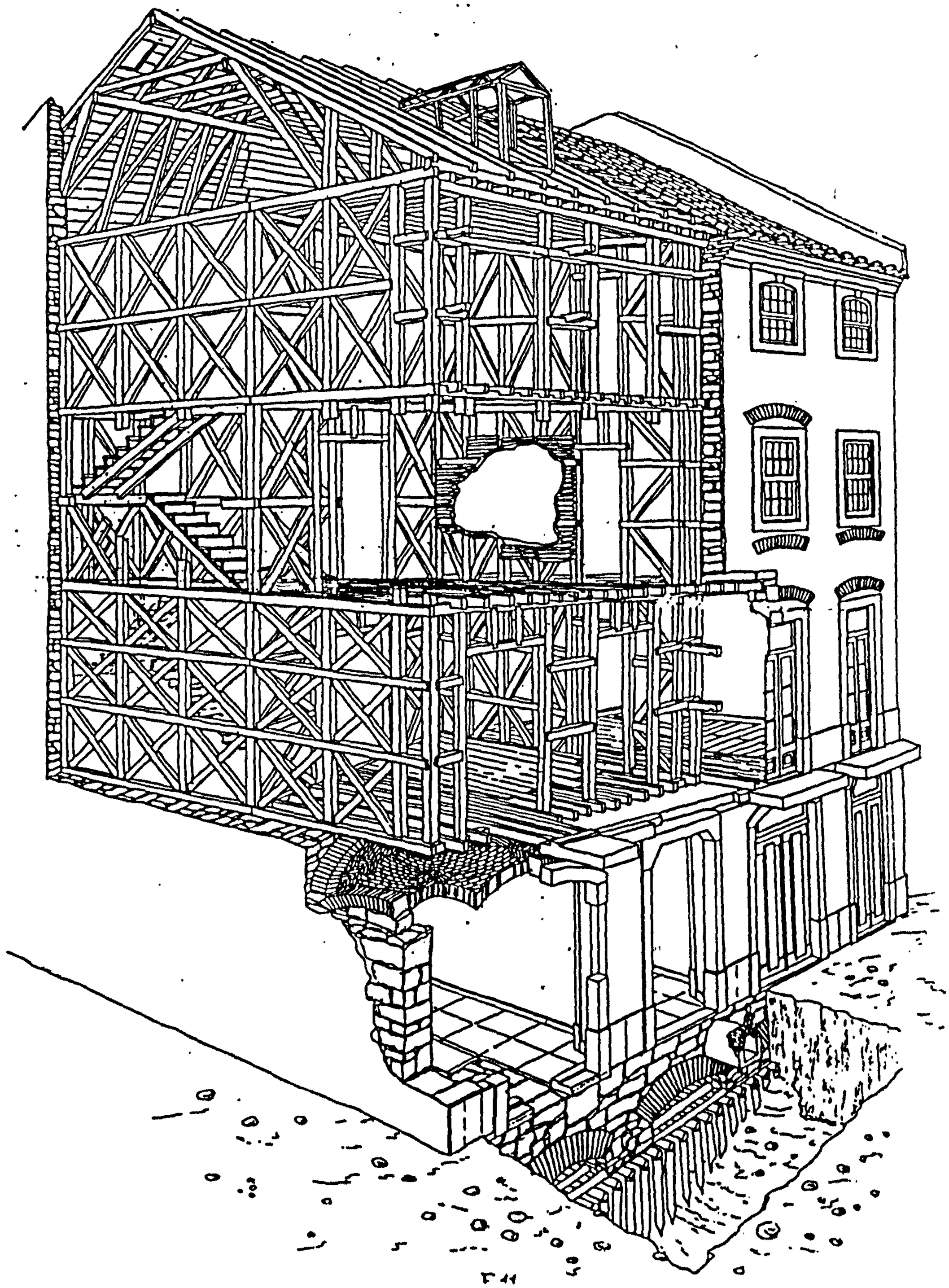


Fig.3.145-Perspective showing the construction, (building F)

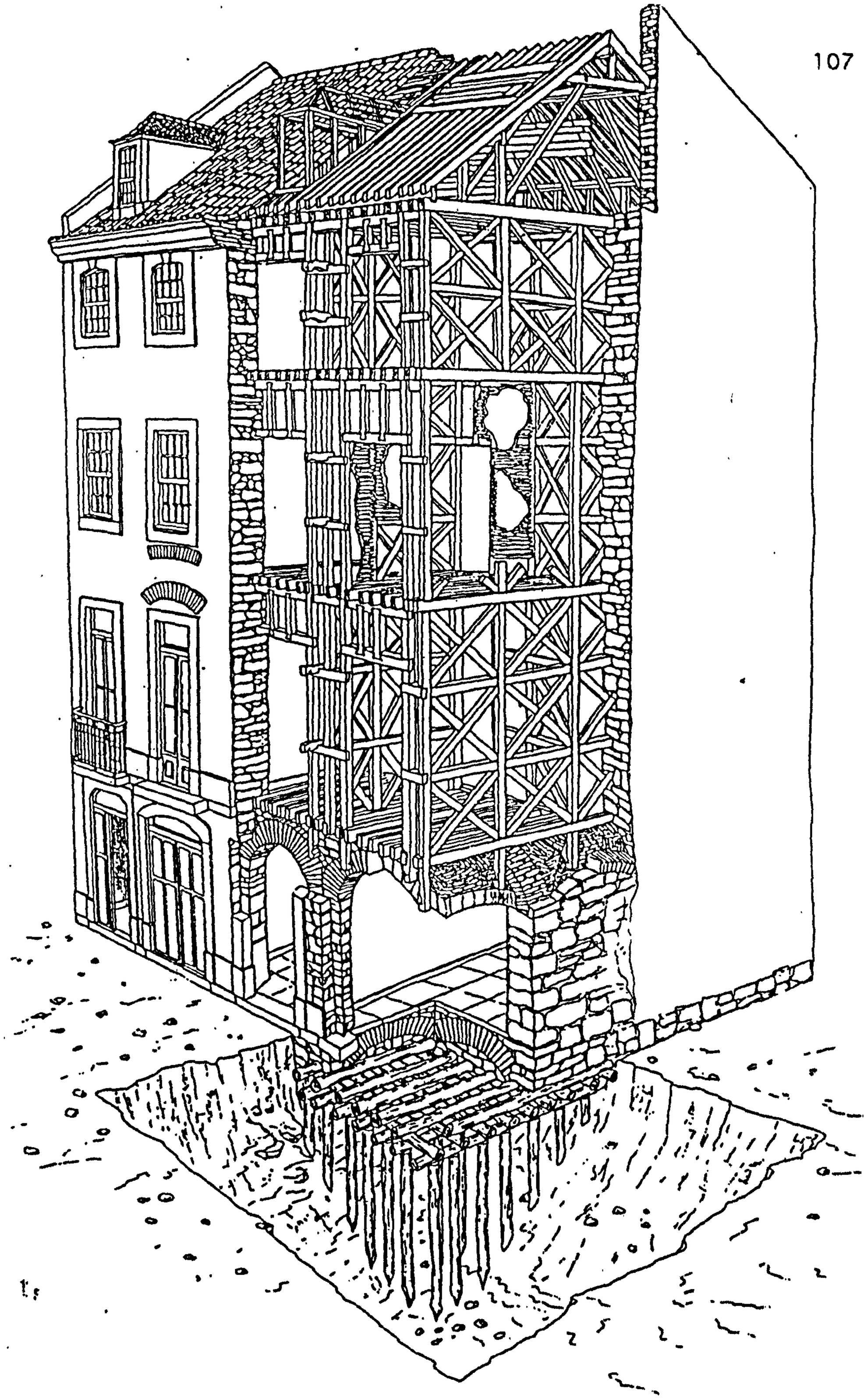


Fig.3.146-Perspective showing the construction, (building G)

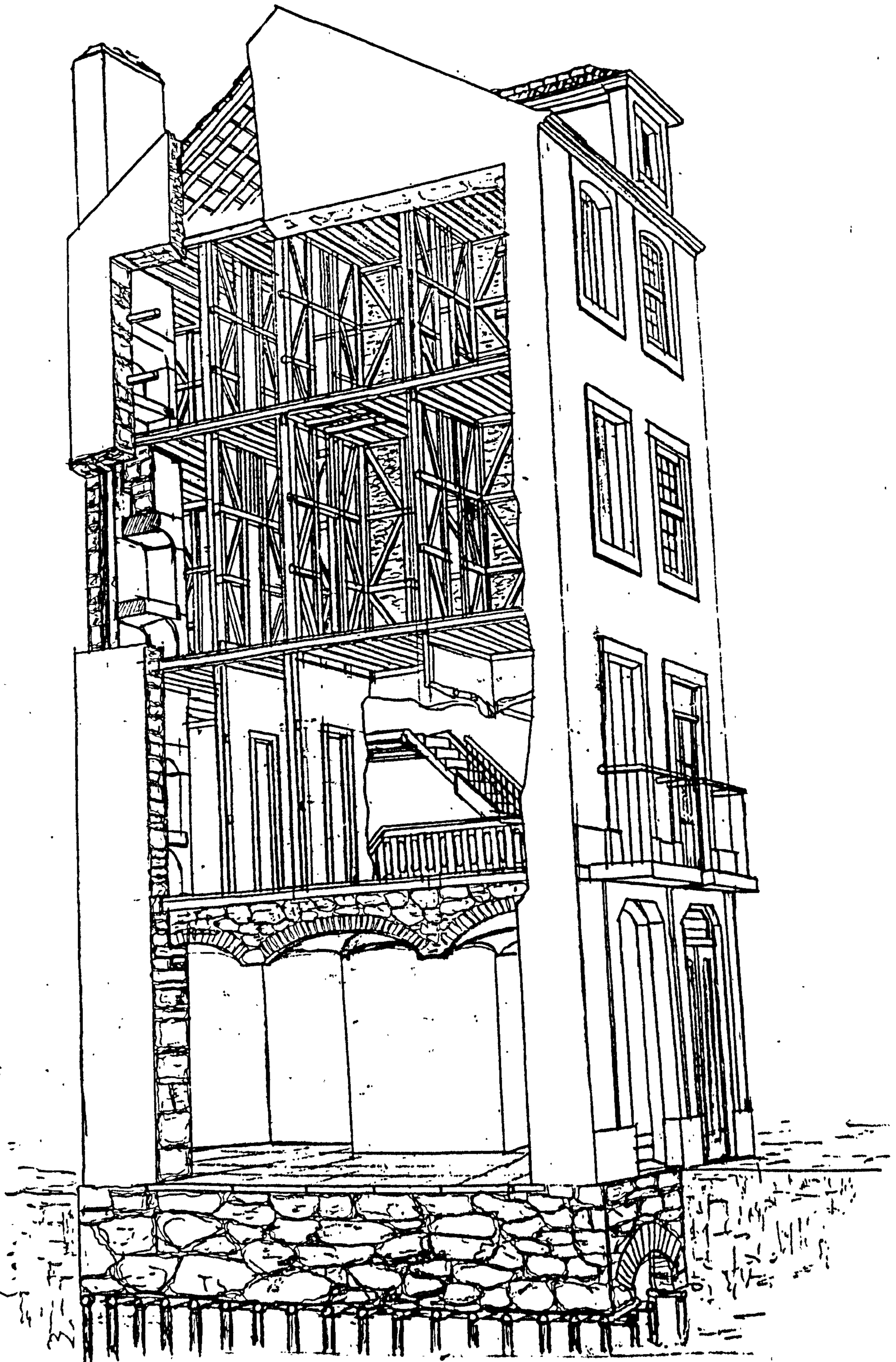


Fig.3.147-Perspective showing the construction, (building Q)

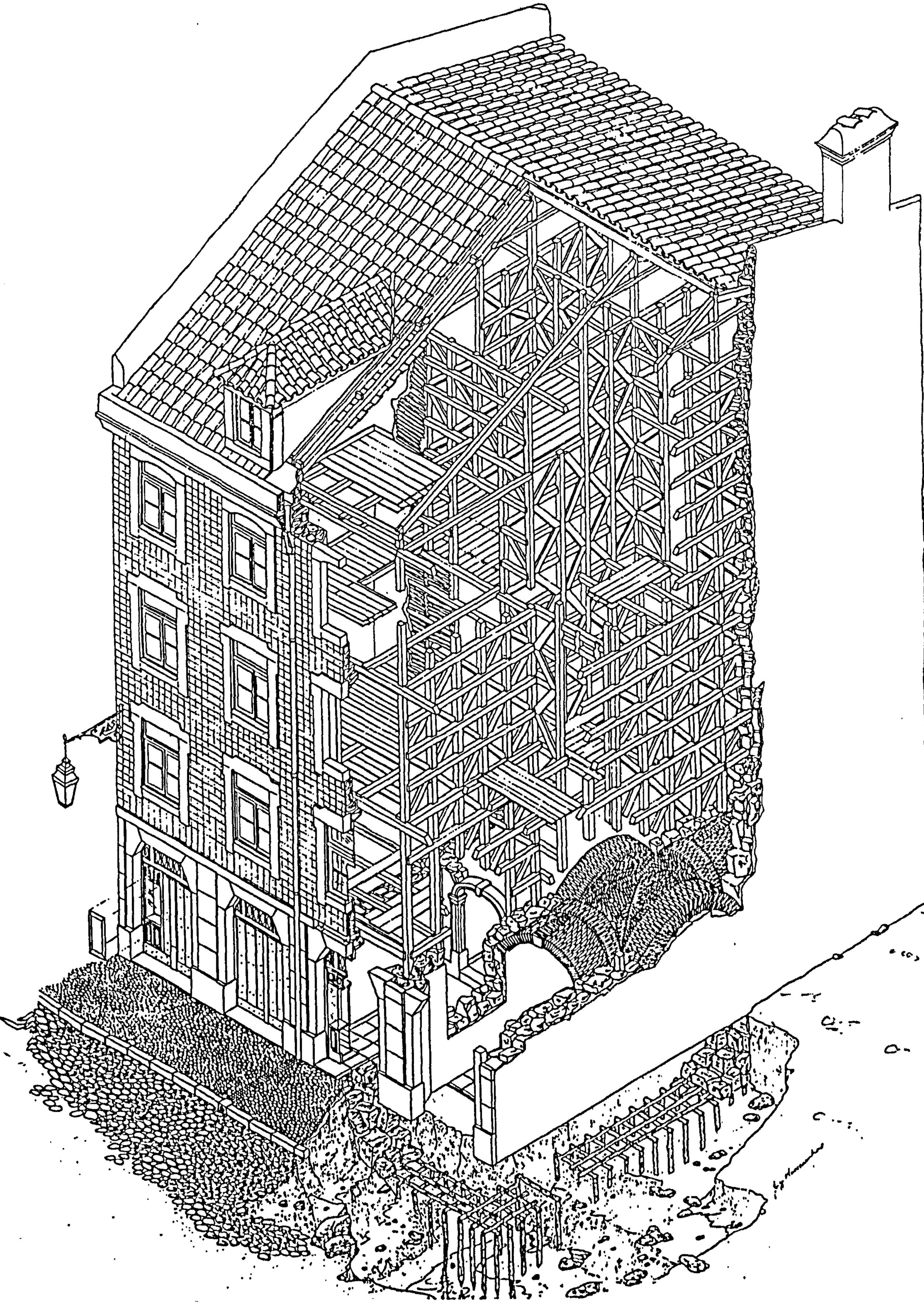


Fig.3.148-Isometric showing the construction, (building M)

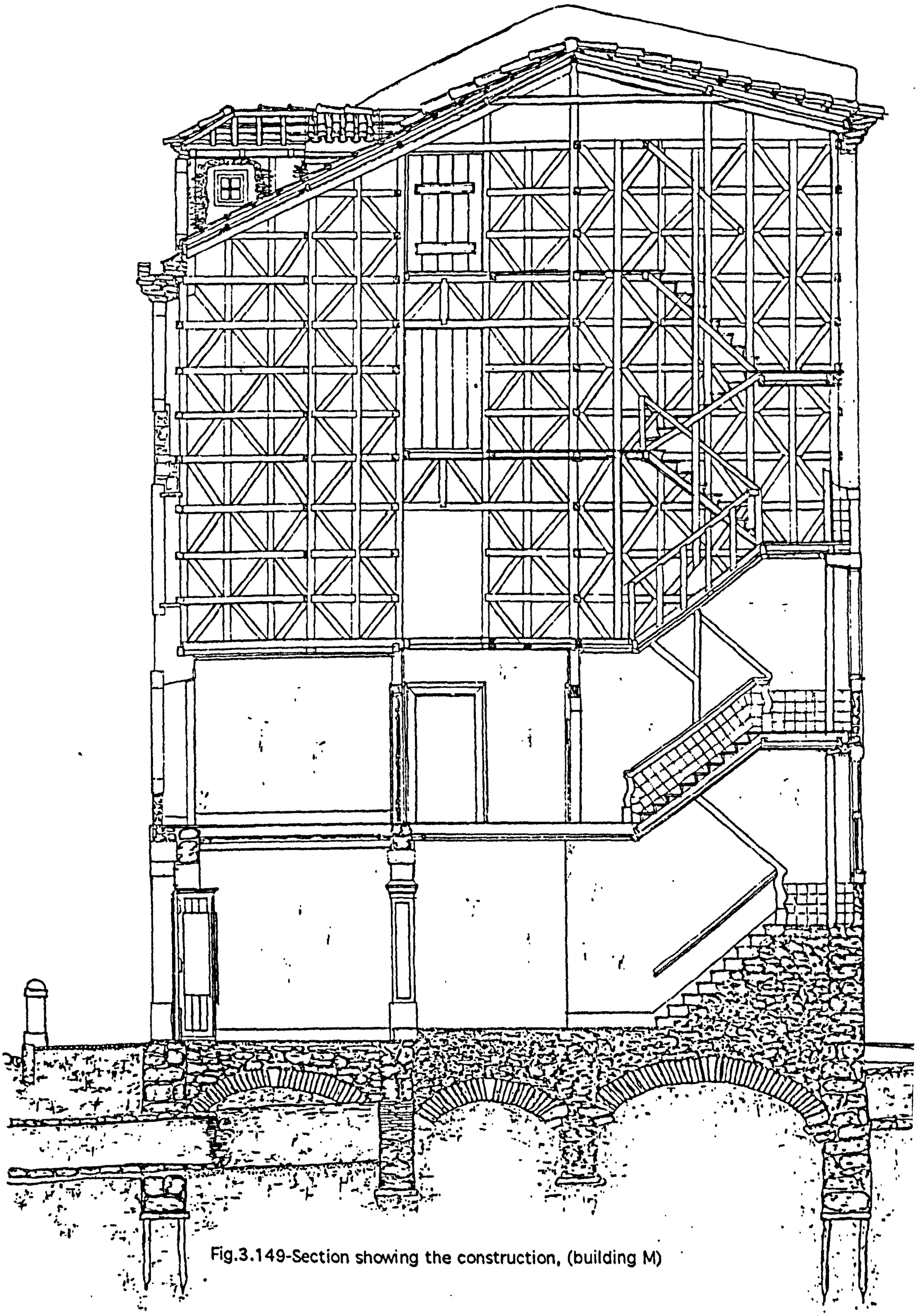


Fig.3.149-Section showing the construction, (building M)

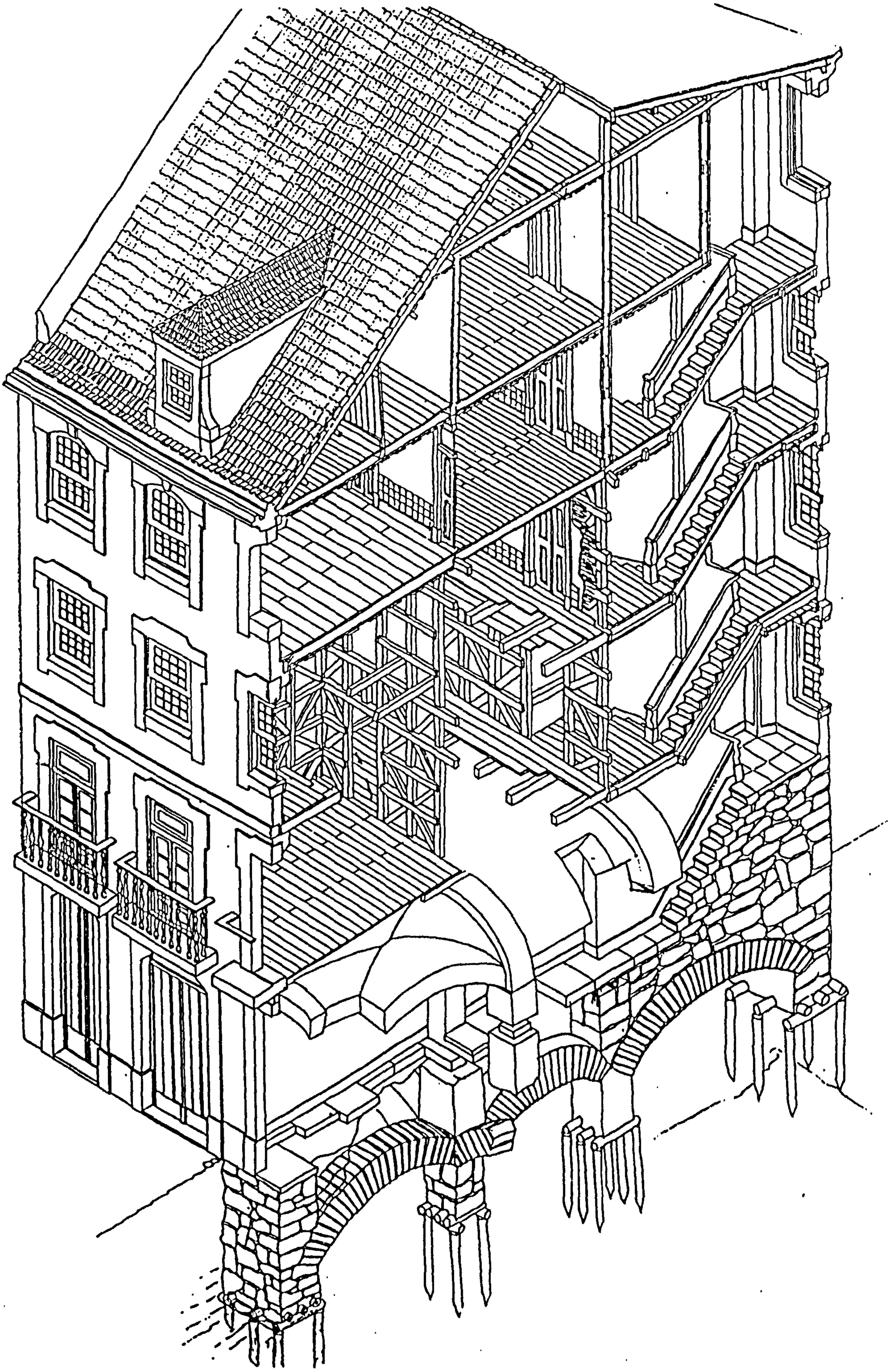


Fig.3.150-Isometric showing the construction, (building M)

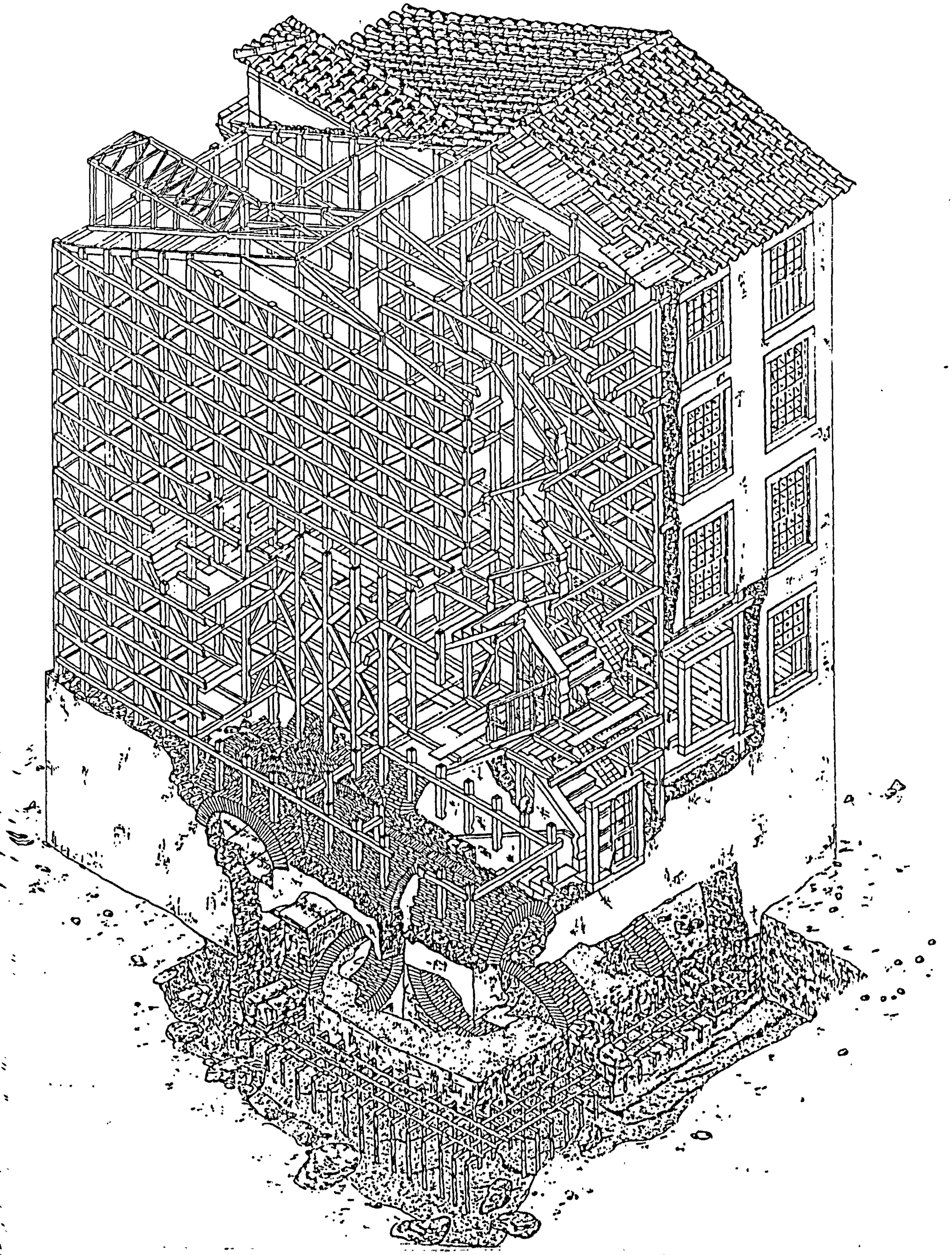


Fig.3.151-Isometric from *alfugere* showing the construction, (building M)

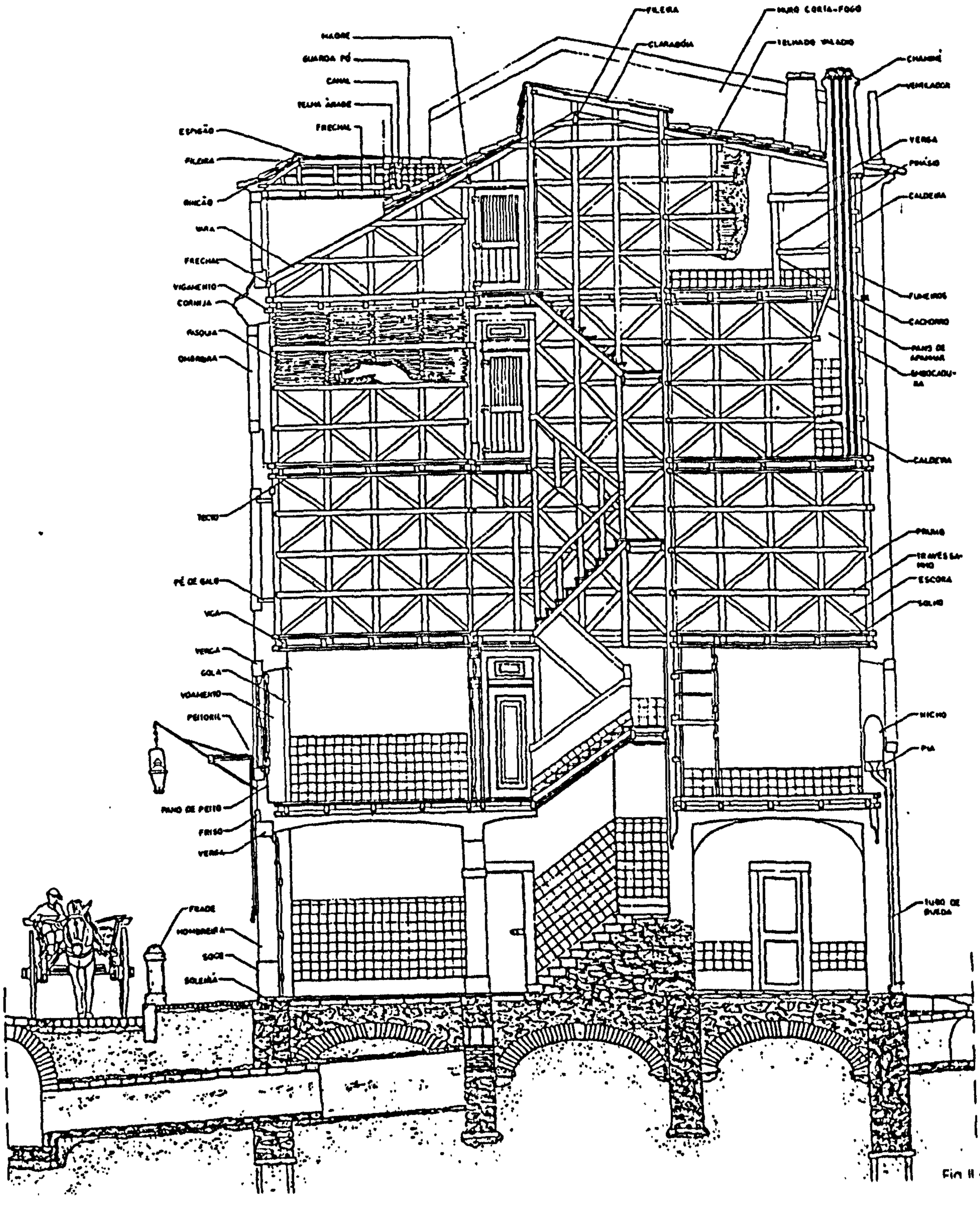


Fig.3.152-Construction section, (building L).

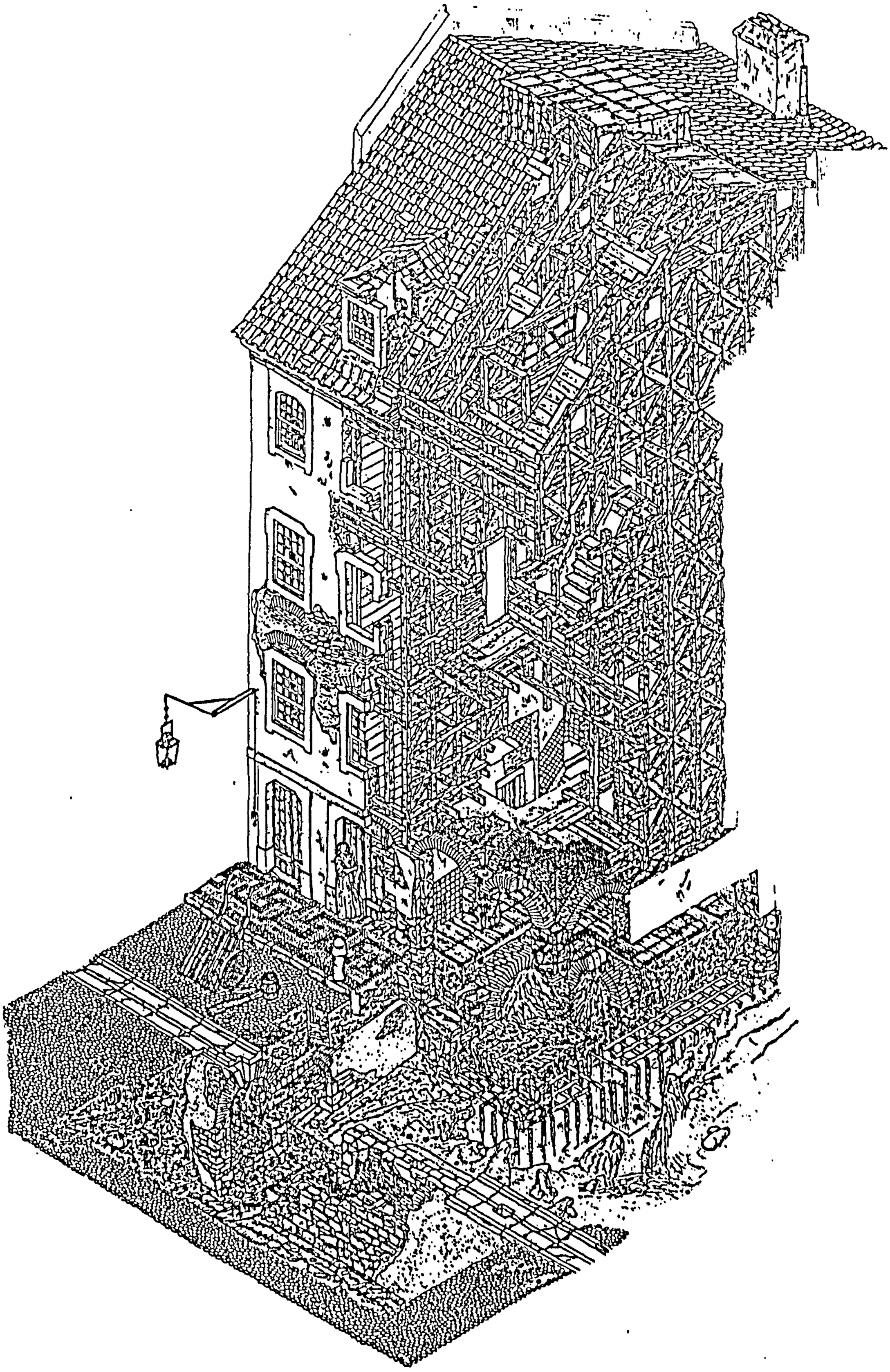


Fig.3.153-Isometric showing the construction as originally built, (building L)

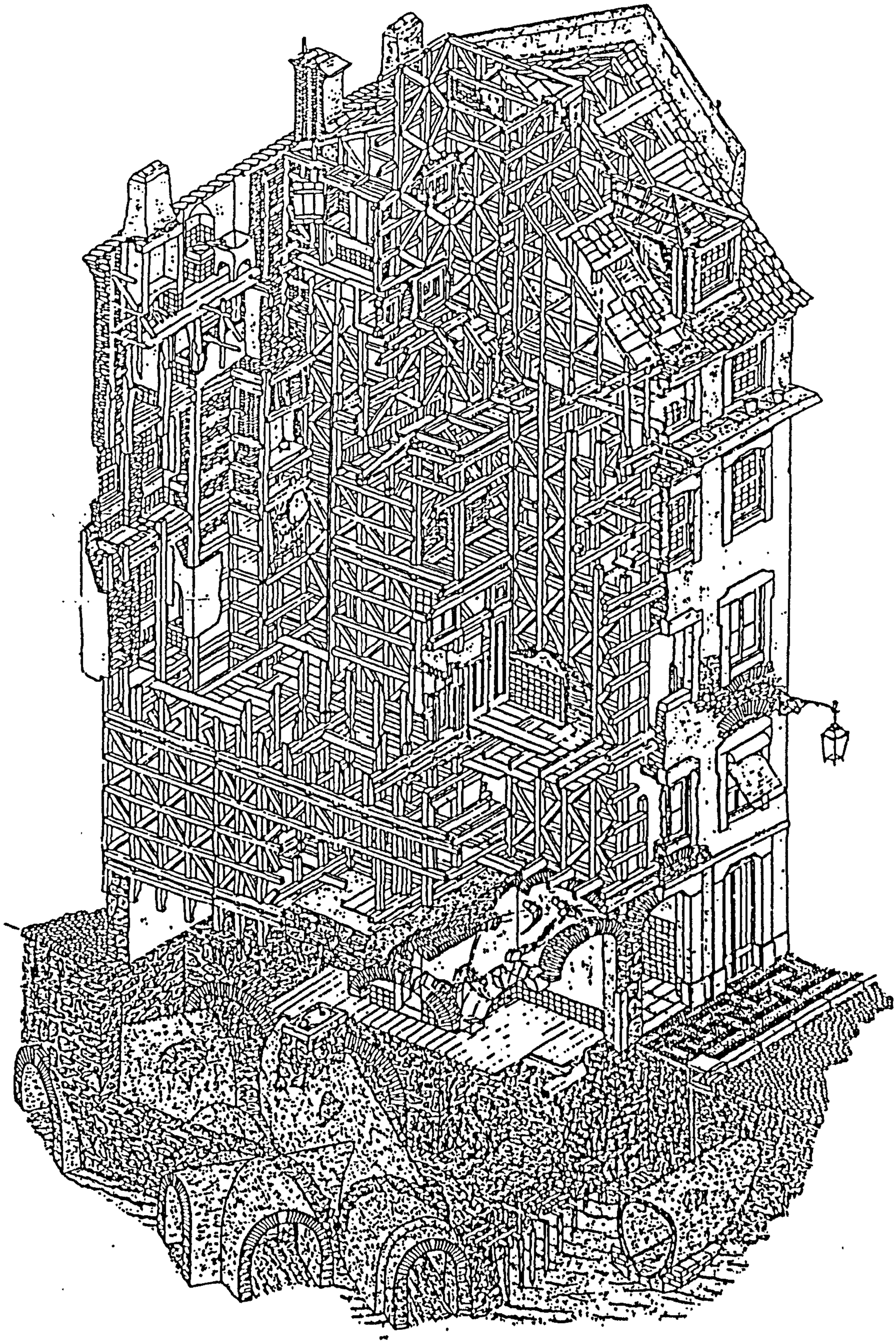


Fig.3.154-Isometric showing the construction with the later extension, (building L)

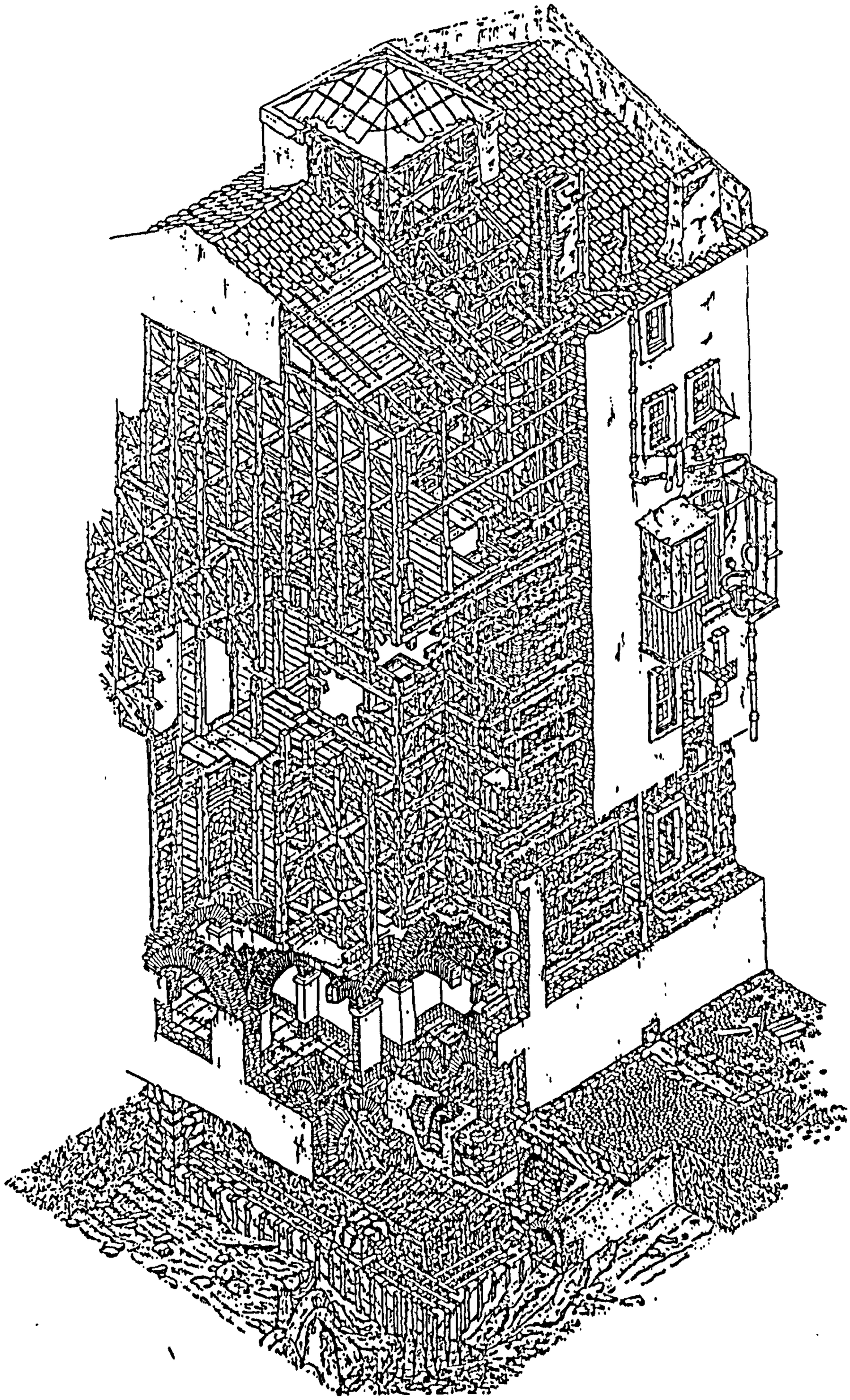


Fig.3.155-Isometric (from *alfugere*) showing the construction with the later extension, (building L)

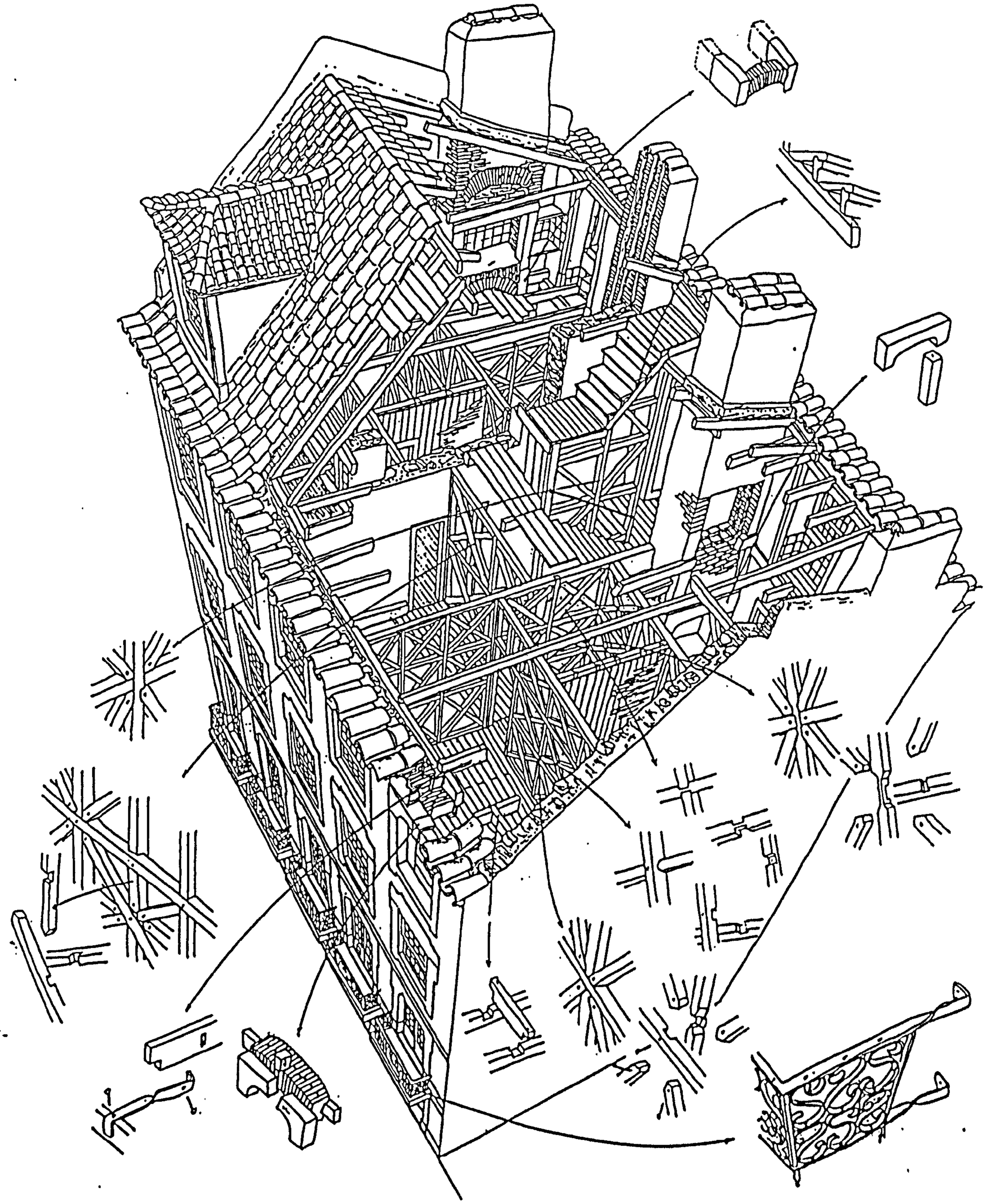


Fig.3.156-Perspective showing the construction, (building R)

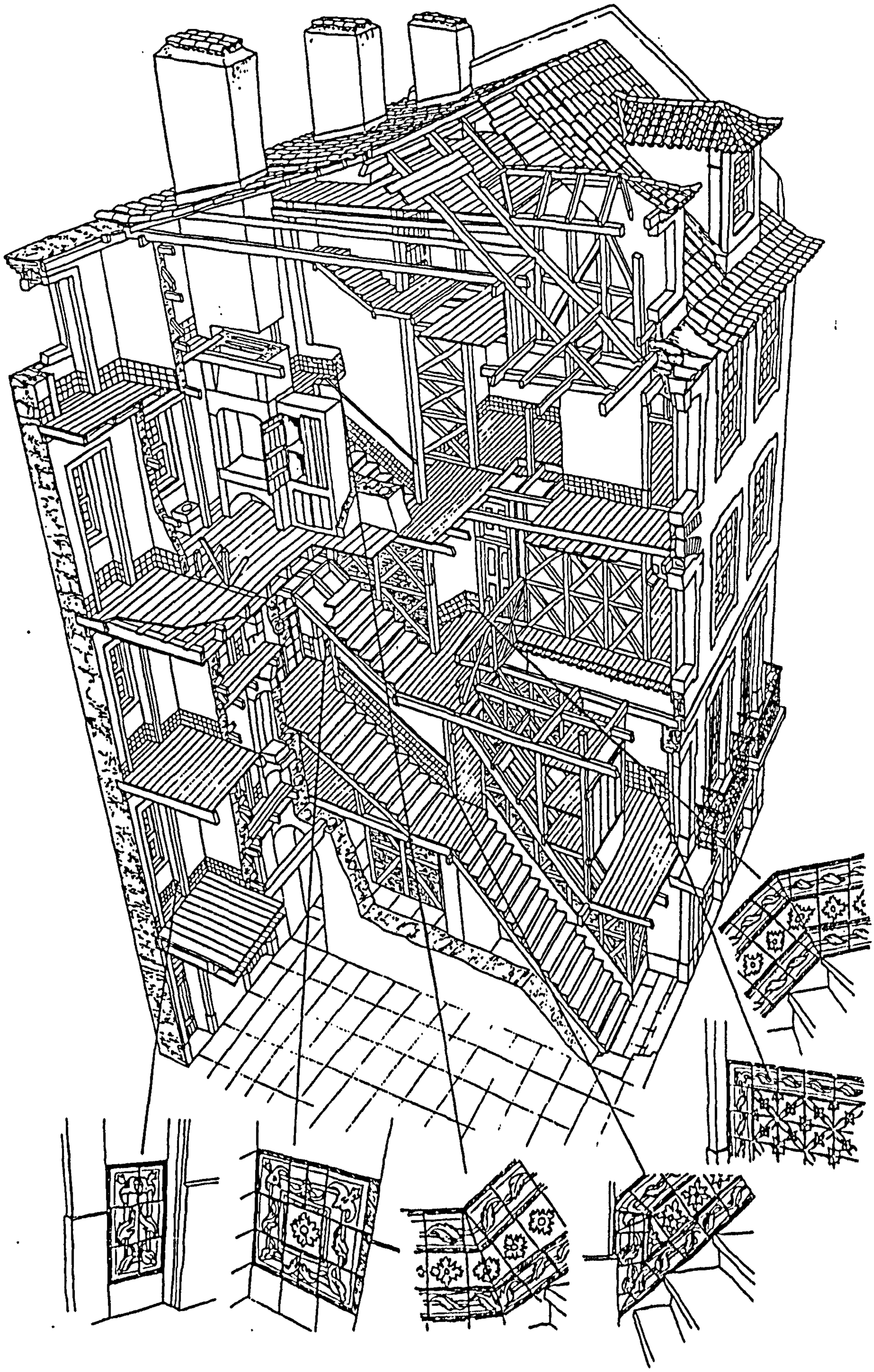


Fig.3.157-Perspective showing the construction and tiles, (building R)

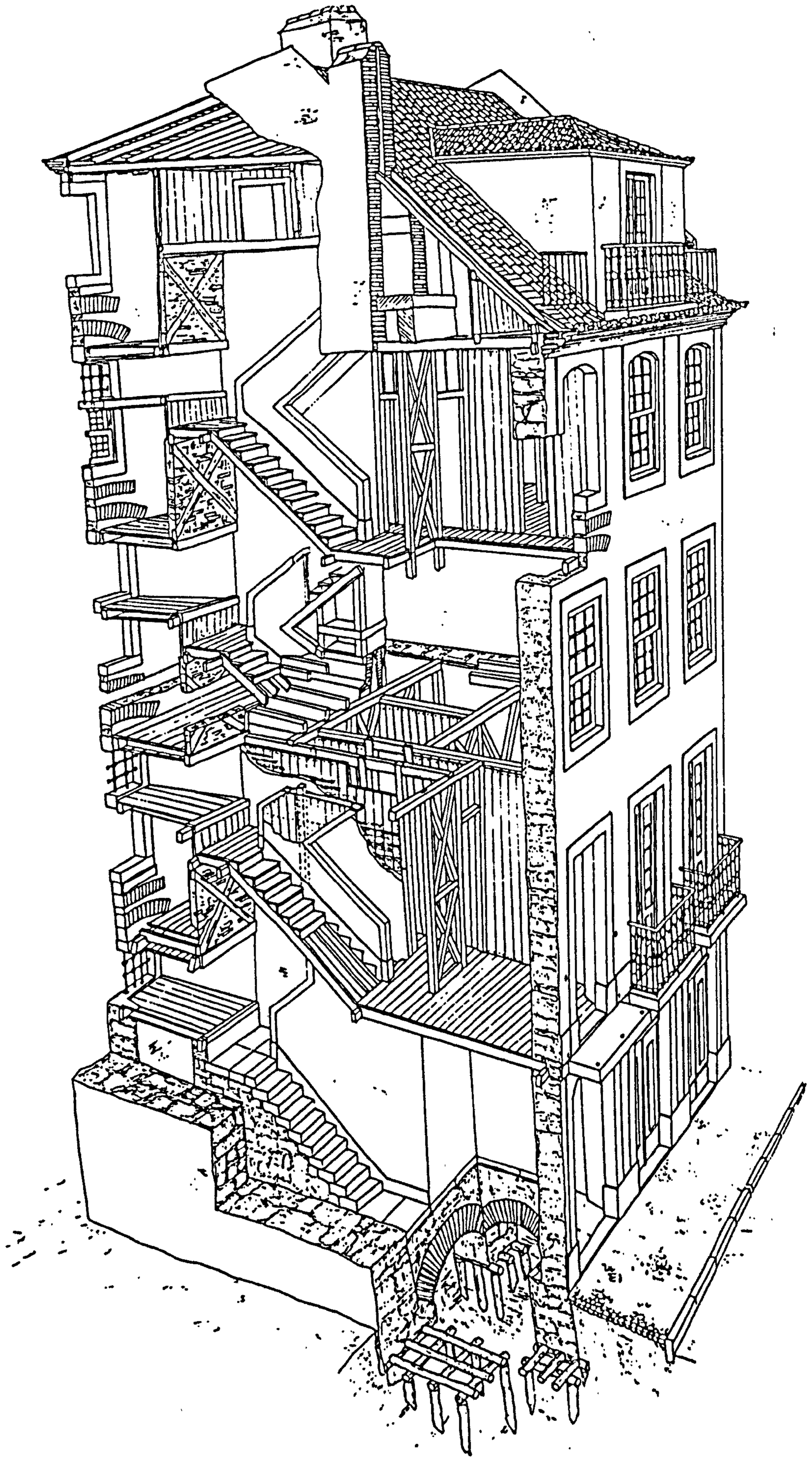


Fig.3.158-Perspective showing the construction, (building S)

Appendix 4 - Supporting historical material relating to the construction period 1755-1820

4.1 Register of tax collection between 1760 and 1840.

4.2 The reconstruction process in relation to key historical events.

4.3 References to the chronology of the reconstruction.

4.4 Completed buildings (by street) between 1766 and 1788
(After Luís Pastor de Macedo[32])

4.5 Records of building contracts during the construction period.

i) Source of references to the contracts.
ii) Resumé of significant aspects of the contracts.
iii) First example of a contract of 1760 and respective translation.
iv) Second example of a contract of 1776 and respective translation.

4.6 Letter from António Pardal Monteiro and respective translation.

In this appendix the author has brought together data from research done on records of the progress of construction in the development area and of evidence of prefabrication. Section 4.1 refers to the survey carried out in the archives of the Tribunal de Contas, into the collection of taxes during the reconstruction period, in three streets. Section 4.2 examines the development of the reconstruction in a historical context. Section 4.3 refers to accounts from the period about the reconstruction and in Section 4.4 to facts presented by a Lisbon writer. In addition to this, there is some documentation of great relevance to the investigation regarding the prefabrication of buildings. Section 4.5 deals with building contracts of the period with reference to prefabrication and section 4.6 contains a letter written to the author by an architect descended from a family involved in the reconstruction over several generations.

4.1 Register of tax collection between 1760 and 1840.

Source:

DÉCIMA DA CIDADE DE LISBOA E O SEU TERMO 1760-1840,

not published, owned by the Arquivo Histórico do Tribunal de Contas, serial volumes 0302 (streets), Lisbon.

Observations:

-Augusta Street belongs to two different parishes.

-The numbers of the owners or properties do not correspond with the numbers of doors. In 1830 it appears that the number of doors, was different from today, so that is why the right or left side of the street has odd and even numbers.

-The names are written as in the original document, in Archaic Portuguese.

-Between 1760 and 1830, some corner buildings changed from one street to another or in some cases from one parish to another, for example in 1782 Augusta Street had 51 buildings, in 1790, in 1801 71 buildings and later 51 buildings.

Chronology of building construction on some streets

	facts
1762/63	1760-Started the reconstruction process
Aurea-7	-Manuel da Maia died
Augusta-18	1763-Carlos Mardel died
Sapateiros-	
Correeiros-	
Conceição-3	
S. Julião-4	
1769	1769-Public selling of unbuilt properties
Aurea-7	1771-Public selling of unbuilt properties
Augusta-42	
Sapateiros-3	
Correeiros-	
Conceição-6	
S. Julião-9	
Arsenal-5	
Comércio-7	
Prata-4	
1782	1777-The King D. Jose I died and Marquis of Pombal was banished from the Court. -The Court moved to Queluz as a rejection of Pombal's Lisbon.
Aurea-7	
Augusta-51	
Sapateiros-11	
Correeiros-3	
Conceição-10	
S. Julião-11	
Prata-13	
Douradores-6	
S. Nicolau-2	
1790	1800-War with Spain
Aurea-14	
Augusta-51	
Sapateiros-16	
Correeiros-23	
Conceição-11	
S. Julião-14	
Prata-12	
1801	
Aurea-19	1806-1st French invasion, the Royal family took refuge in Brazil.
Augusta-51	1809-2nd French invasion
Sapateiros-15	
Correeiros-22	
Conceição-12	
S. Julião-17	
S. Nicolau-2	
Prata-15	
Douradores-4	
1810	1810-Commercial treaty with England
Aurea-19	1810/11-3rd French invasion
Augusta-54	1815-Brazil became Kingdom of Portugal
Sapateiros-16	1816-The Queen D. Maria died
Correeiros-23	1818/1834-Liberal revolution
Conceição-11	
S. Julião-15	
Prata-15	
Douradores-9	
1820	
Aurea-19	1821-Portugal became again a Kingdom
Augusta-55	1822-Independence of Brazil
Sapateiros-16	1820-The absolutists' intentions
Correeiros-23	
Conceição-11	
S. Julião-17	
S. Nicolau-8	
Vitoria-9	
Arsenal-6	
Assunção-5	
Santa Justa-11	
1831	
Aurea-18	1832/34-Important Liberal fights
Augusta-55	1834-Religious orders were extinct
Sapateiros-16	-The King D. Pedro IV died
Correeiros-23	
Conceição-11	
S. Julião-17	

AUGUSTA STREET -Parish of S. Julião- Augusta

Street, right side from Comércio Square; Ouro Street, left and right sides from Comércio Square; S. Julião Street, left and right sides from Boa Hora; Conceição Street, right and left sides from Boa Hora; Nova do Almada left and right sides; Ribeira das Naus Street; Nova Del Rei Street and Santa Justa Street.

1762/63 (S. Julião 572)

Right/from Comércio Square
1.91-
2.193
3.191-Ordem Gregoriana de S. Francisco
4.101-Irmandade do Santíssimo Sacramento
5.30
6.187
7.184-Irmandade da Congregação da ...
8.29-Francisco Gl. Marquis
9.180-Luis Seriqueiro?
10.178-Propriedade da Igreja Patriarcal
11.174-Francisca Teresa viúva de Eugénio dos Santos
12.171-António Groyamo Raposo
Left/from Comércio Square
13.88
14.7-
15.29-Feliz Lafuafa?
16.12-D. Rodrigo António de Noronha Meneses
17.103
18.27-António Lourenço de Seixas
19.21
20.26
21.52
22.104

1769 (S. Julião 575)

Right/from Comércio Square
1.91-Ambrósio Araújo de Sá
2.193- Dr. João Tavares de Almeida
3.191- Ordem 3ª de S. Francisco
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Manuel Gemarains (Guimarães)
6.187 -D. Bras Baltazar da Silveira
7.184-Irmandade da Doutrina
8.29-João Rodrigues Caldaz
9.180-Jose Ferreira Dias
10.178-Santa Igreja da Pratriarcal
11.174 -João Gonçalves Rebello
12.171-Padre António Rapozo
Left/from Comércio Square
13.88-Manuel José Curvo Semedo
14.7-José Lopes de Miranda
15.29-Marcos Alves Lima
16.12-Dom Bras Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-Antonio Lourenço Seixas
19.21-Manoel dos Santos Loppes
20.26-João Costa Araújo
21.52-João Dias da Silva
22.104-?

1780 (S. Julião 579)

Right/from Comércio Square
1.91-Ambrósio Araújo de Sá
2.193- Herdeiros de Dr. João Tavares de Almeida
3.191- Ordem da Luz Branca
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Manuel Gemarains (Guimarães)
6.187 -D. Bras Baltazar da Silveira
7.184-Misericórdia
8.29-João Rodrigues Caldaz
9.180-Jose Ferreira Dias
10.178-Santa Igreja da Pratriarcal
11.174 -João Gonçalves Rebello
12.171-Padre António Rapozo
Left/from Comércio Square
13.88-Manuel José Curvo Semedo
14.7-José Lopes de Miranda
15.29-Marcos Alves Lima
16.12-Dom Bras Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-Antonio Lourenço Seixas
19.21-Manoel dos Santos Loppes
20.26-João Costa Araújo
21.52-João Dias da Silva
22.104-Custódia Maria do Nascimento

1790 (S. Julião 582)

Right/from Comércio Square
1.91-Dom Joaquim de Menezes
2.193- Herdeiros de Dr. João Tavares de Almeida
3.191- Ordem 3ª de S. Francisco
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Manuel António da Silva Bravo
6.187 -D. Bras Baltazar da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Caldaz
9.180-António Nunes Galvão
10.178-Santa Igreja da Pratriarcal
11.174 -Herdeiros João Gonçalves Rebello
12.171-Herdeiros do Padre António Rapozo
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Lopes de Miranda
15.29-D. Eucolastica Maria de Santo António
16.12-Dom Bras Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-Antonio Lourenço Seixas
19.21-Manoel dos Santos Loppes
20.26-Herdeiros de João Costa Araújo
21.52-D. Ritta Gertrudes Margarida Marreca
22.104-D. Lourenço

1799 (S. Julião 584)

Right/from Comércio Square
1.91-Doutor Xavier Araújo
2.193- Herdeiros de Dr. João Tavares de Almeida
3.191- Ordem 3ª de S. Francisco
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Manuel António da Silva Bravo
6.187 -D. Bras Baltazar da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Caldaz
9.180-António Gonçalves
10.178-Santa Igreja da Pratriarcal
11.174 -Herdeiros João Gonçalves Rebello
12.171-José Gonçalves Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Lopes de Miranda
15.29-José Lopes Alves
16.12-Dom Bras Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-Antonio Lourenço Seixas
19.21-Manoel dos Santos Loppes
20.26-Herdeiros de João Costa Araújo
21.52-D. Ritta Gertrudes Margarida Marreca
22.104-Freguesia de S. Nicolau

1810 (S. Julião 586)

Right/from Comércio Square
1.91-Francisco Correia Borges
2.193- António José da Fonte
3.191- Ordem 3ª de S. Francisco
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Manuel António da Silva Bravo
6.187 -D. Nuno José Baltazar Piedade da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Caldaz
9.180-António Gonçalves
10.178-Francisco Pereira Lima
11.174 -Herdeiros João Gonçalves Rebello
12.171-Manuel José Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-Herdeiros de José Lopes de Miranda
15.29-José Lopes Alves
16.12-Dom Nuno Maria Baltazar Silveira
17.103-Jose Pereira de Almeida
18.27-Antonio Lourenço Seixas
19.21-Jacinto Pereira Lima
20.26-Herdeiros de João Costa Araújo
21.52-D. Ritta Gertrudes Margarida Marreca
22.104-Freguesia de S. Nicolau

1820 (S. Julião 588)

Right/from Comércio Square
1.91-Francisco Correia Borges
2.193- António José da Fonte
3.191- Ordem 3ª de S. Francisco
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Francisco Saraiva
6.187 -D. Nuno José Baltazar Piedade da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Caldaz
9.180-António Gonçalves
10.178-Francisco Pereira Lima
11.174 -Herdeiros João Gonçalves Rebello
12.171-Manuel José Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Ferreira Troca
15.29-Sebasteão José Oliveira Guimarães
16.12-Dom Nuno Maria Baltazar Silveira
17.103-Dona Joaquina Gertrudes de Almeida
18.27-Antonio Lourenço Seixas
19.21-Jacinto Pereira Lima
20.26-Herdeiros de João Costa Araújo
21.52-D. Ritta Gertrudes Costa
22.104-Freguesia de S. Nicolau

1830 (S. Julião 589)

Right/from Comércio Square
1.91-Francisco Correia Borges
2.193- António José da Fonte
3.191- Ordem 3ª de S. Francisco
4.101-Irmandade do Santíssimo Sacramento de S. Julião
5.30-Francisco Saraiva
6.187 -D. Nuno José Baltazar Piedade da Silveira
7.184-Hospital Real de S. José
8.29-João Rodrigues Caldaz
9.180-António Gonçalves
10.178-Francisco Pereira Lima
11.174 -Herdeiros João Gonçalves Rebello
12.171-Manuel José Marques
Left/from Comércio Square
13.88-Herdeira de Manuel José Curvo Semedo
14.7-José Ferreira Troca
15.29-Sebasteão José Oliveira Guimarães
16.12-Dom Nuno Maria Baltazar Silveira
17.103-Dona Joaquina Gertrudes de Almeida
18.27-Antonio Lourenço Seixas
19.21-Jacinto Pereira Lima
20.26-Herdeiros de João Costa Araújo
21.52-D. Ritta Gertrudes Costa
22.104-Freguesia de S. Nicolau

AUGUSTA STREET — Parish of S. Nicolau

Duque, Carmo, Sapateiros, Manuel Gonçalo Streets; Augusta Street, left and right sides; Bela Rainha Street, right side; Conceição Street, right side; Crucifixo street, right side; Nova do Almada Street; Nova do Carmo Street; Ouro Street and Rossio Square.

1762/63 (S. Nicolau 787)

1-António Ribeiro da Silva
2-João Pires
3-Pedro Rangel
4-Cechose? Marques
5-Pedro Cardoso Pixileiro
6-Gabieui Gró?
7-Lourenço da Silva

1769 (S. Nicolau 789)

Left/from Comércio Square
17-João Henriques de Sousa
18-Rodrigo Caetano de Almeida
19-Pedro da Costa Guimarães
20-José Rodrigues Bandeira
21-José Rodrigues Bandeira
22-Senado da Câmara
23-José da Costa Soares
24-Padre Domingos dos Santos
25-Maria João...
26-Patrício Brau?
27-Francisco Silva e Abreu
28-Conde de Óbidos
29-Religiosas do Convento
Right/from Comércio Square
30-João Dos Santos Mattos
31-Maria Joaquina de Mello
32-Pez? da Graça
33-Maria Pereira
34-Pedro Manso rangel
35-Francisco Sales Monteiro
36-Joaquim José Perez
37-António José Rebelo
38-José Antunes
39-Manuel Francisco
40-Herd. de António Ribeiro da Silva
41-Domingos Bastos Viana
42-Amaro Monteiro da Cunha
43-Padres da Congregação
44-José Domingos
45-José da Mata
46-D. Juliana de Menezes
47-Joaquim Alves Guerra
48-Teles Teixeira Matos
49-Teles Teixeira Matos

1780 (S. Nicolau 794)

Right and left /from Comércio Square
58-Josefa Maria de Jesus
59-Maria Joaquina de Melo
60-Padres da Graça
61-João Gonçalves Rabello
62-José dos Reis
63-Manço Rangel
64-Dezembargador Luis Ribeiro Quintella
65-Francisco de Salles
66-Francisco da Silva
67-Joaquim José Pires
68-Duque do Cadaval
69-António José Rebello
70-José Antunes
71-Francisco Xavier da Sepulveda
72-Herdeiros do Dezembarcador Luis Estanilao da Cunha Coelho
73-Junta do Comércio
74-Domingos Bastos Viana
75-António da Costa
76-Amaro Monteiro
77-Manuel Pereira
78-Padres da Congregação
79-José Domingues
80-Herd. de José Matta
81-Juliana Menezes
82-Joaquim Alves Guerra
83-Felix Teixeira de Matos
84-Felix Teixeira de Matos
85-Amaro Monteiro
86-Antonio da Costa Araújo

1790 (S. Nicolau 799)

Left/from Comércio Square
57-Gaspar Tavares
58-Maximiliano Fernandes Oliveira
59-Maximiliano Fernandes Oliveira
60-Herdeiros de José Rodrigues
61-Pedro Azevedo Vaquente?
62-José Frederico Ludovice
63-Patriarcal
64-Herdeiros de Domingos dos Santos franco
65-Herdeiros de Maria João
66-Padres Paulistas
67-José Domingues
68-Herdeiros de João Fernandes Oliveira
69-Herdeiros de João Fernandes Oliveira
70-Herdeiros de João Fernandes Oliveira
71-Machado Miranda
72-José Domingues
73-Herdeiros José antónio Monteiro
74-Conde de Obidos
75-Herdeiros de José António Monteiro
76-Herdeiros de Jose Joaquim Essay?
77-Religiosas da Esperança
78-?

Right/from Comércio Square
79-Josefa Maria de Jesus
80-Maria Joaquina de Mello
81-Padres da Graça
82-Manuel Joaquim Rabello
83-José dos Reis
84-Pedro Manço Rangel
85-José Joaquim Emmais
86-Francisco Salles monteiro
87-António Francisco da Silva
88-Joaquim Jose Pires
89-Duque do Cadaval
90-Herdeiros Antonio José Rebello
91-José Antunes
92-Francisco Xavier Sepulveda
93-Lescade? Leira?
94-Jose António Monteiro
95-Domingos de Bastos Vianna
96-Luis Rodrigues Caldas
97-?
98- Manuel Teixeira Guimarães
99-Congregação do Cartório
100-José Domingues
101-José Mata
102-D. Juliana de Menezes
103-Herdeiros de Joaquim Alves Gama
104-Telles Teixeira de Mattos
105- Alexandre José Teixeira

1801 (S. Nicolau 804)

Left/from Comércio Square
140-Gaspar Alvarez
141-Herdeiros de Maximiliano FernandesOliveira
142-António José Moreira
143-D. Mariana Joaquina Palela Balarte Dique
144-Pedro Azevedo Vagunte
145-José Frederico Ludovice
146-Igreja Patriarcal
147-Dona Maria da Assunção Ulblina de Mello
148-joão luiz do Cabo
149-Padres Paulistas
150-Joaquim José Domingues
151-Joaõ Fernandes de Oliveira
152-Joaõ Fernandes de Oliveira
153-Joaõ Fernandes de Oliveira
154-Alexandre Nunes Monteiro
155-Joaquim José Domingues
156-António José de Sousa
157-Conde de Óbidos
158-Herdeiros de Jose António monteiro
159-João Pedroso Pixileiro
160-Religiosas da Esperança.
Right/from Comércio Square
161-Matheus Gonçalves dos santos
162-Padres da Graça
163-Viuva de Manoel Joaquim Rabelo
164-Jose dos Reiz
165-Pedro Manço Rangel
166-Ant. Luiz Ignácio Quintela
167-Francisco Salles Monteiro
168-Antonia Francisca da Silva
169-Joaquim Jose Pires
170-Duque do Cadaval
171-Joaquim Gonzaga
172-Jose Antunes
173-Francisca Xavier Sepulveda
174-Dona Leocadia Luiza
175-Antonio Jose de Sousa
176-Domingos Bastos Vianna
177-Antonio Francisco Machado
178-Paula Joaquina
179-Sebastião Antonio Gomes de Carvalho
180-Padres da Congregação
181-Dona Anna de Aquino
182-Antonio Joaquim de Moraes
183-Dona Juliana de Menezes
184-Manuel Alves Guerra
185-Alexandre Jose Ferreira Castello
186-Alexandre Jose Ferreira Castello

1812 (S. Nicolau 806)

Left/from Comércio Square
131-João Pera Guimarães
132-Antonio Jose Sousa
133-Conde de Bobadela
134-Antonio Jose de Silveira
135-Joaquim Jose Gomes
136-D. Anna Maria Oliveira Forjo
137-D. Anna Maria Oliveira Forjo
138-João Luis Calvo
139-Maria Assunção Umbelina de Mello
140-Francisco Ambrosio Leal
141-Manuel Ferreira Garcês
142-Antonio Jose Moreira Silva
143-Antonio Jose Moreira Silva
Right/from Comércio Square
144-José Ferreira Castelo
145-José Ferreira Castelo
146-Manuel Alvaro Guerra
147-Antonio Basto
148-Maria Madalena Moraes
149-Sebasteão Antonio Gomes de Carvalho
150-Paula Joaquina Ignácia
151-Antonio Francisco Machado
152-Francisco Marques
153-Mariana Encarnação
154-Jose Antonio Lima
155-Thome Joaquim Gonzaga
156-Duque do Cadaval
157-Real Fazenda
158-Antonio Francisco da Silva
159-Antonio Simões Rosado
160-Jose Maria Rapozo
161-Jose dos Reis
162-Maria do Carmo

1821 (S. Nicolau 810)

Left/from Comércio Square
132-Manuel Flora
133-João Batista da Silva
134-Conde de Obidos
135-Herdeiros de Antonio Jose da Silva
136-Felix Costa
137-D. Anna de Oliveira Grijo
138-?
139-Manuel Moreira Marques
140-Herdeiros de Felix
141-Francisco Ambrosio Leal
142-Manoel Fernandes
143-Antonio Jose Moreira
144-?

Right/from Comércio Square
145-Herdeiros de Alexandre Ferreira Castelo
146-?
147-Manuel Alves Guerra
148-Joana Roca Basto
149-Maria Vitória Rocha
150-Antonio Gomes de Campo
151-Antonio Duarte Loures
152-Antonio Francisco tainha
153-Teixeira Marques
154-Antonio Francisco Chaves
155-?
156-Thome Gonzaga
157-Duque do Cadaval
158-Jose Nunes Lobo
159-Antonio Francisco dos santos
160-Antonio Simoes Roubado
161-J.M.
162-Rapozo
163-Francisco Nicolao dos Reis
164-D. Maria do Carmo Alves

1830 (S. Nicolau 812)

Left /from Comércio Square
131.34/36-Manuel Mór Flora
132.37/38-Batista de Sousa
133-?
134.42/44-Antonio Jose de Sousa
135.45/49-Felix Costa
136.60/65-Felix Oliveira G?
137.66/72-Felix Oliveira G?
138.75/78-Manuel Moreira Marques
139.79/82-Filipe Nere da Silva
140.83/85-Francisco Ambbrosio Leal
141.86/89-Mario Ferreira Garces
142.97/98-João Ferreira da Cunha Bastos
143.99/101-Angelo Oliveira

Right/from Comércio Square
144.105/107-Alexandre Jose Ferreira Castro
145.108/109-Francisco Manuel Correia Lopes
146.110/111-Manuel Guerra
147.112/113-Cardeco Subena?
148.114/116-Maria Vitória da Rocha
149.121/122-Sebasteao Gomes de Carvalho
150.123/125-Antonio Duarte Loures
151.126/128-Francisco Machado
152.129//132-Domingos Teixeira Marques
153.133/134-Antonio Francisco Chaves
154.138/139-Francisco?
155.140/142-Thome Joaquim Gonzaga
156.143/147-Duque do Cadaval
157.148/149-Jose Nunes Lobo
158.150/151-Antonio Francisco da Silva
159.153/157-Simoes Roucado
160-Jose Mario Rapozo
161-Francisco Reis
162.162-Duarte Rey
163.163-Maria do Carmo Alves

CONCEIÇÃO STREET (S. Julião 572)

1762/63

22-Gerônimo Vitória
23-Domingas Maria
24-João Ignácio

1769

53-Irmandade do Santíssimo da freguesia da Conceição Nova
54-Gerónimo Vitória
55-Domingas Maria
56-Francisco Ribeiro*
57-António Lourenço Seixas
58-João Ignácio

1782

53-Irmandade do Santíssimo da freguesia da Conceição Nova
54-Gerónimo Vitória
55-Domingas Maria
56-D. José Xavier Telles
57-Francisco Xavier Natal
58-Francisco Ribeiro
59-António Soares
60-António Lourenço Seixas
61-Maria de Sousa Rey
58-João Ignácio

1790

Right
60-Irmandade do Santíssimo da Freguesia da Conceição Nova
61-Gerónimo Vitória
62-Jose Campos Lima
63-Jose Pedro
64-D. Ana Romária Aquino
65 -Ribeiro da Silva

Left
66-Dionízio António
67-Jose Lima marques
68-Pinheiro salgado
69-Pedro Lourenço seixas
70-Luis Santa Marta

1801

Right
58-Santissimo da Conceição
59-Gerónimo Vitória
60-Luis Campos
61-Jose Teles
62-Jose Domingues
63-Francisco Rebelo da Silva
Left
64-Dionízio António
65-Jose Rodrigues Lima
66-Antonio Salgado
67-Antonio Lourenço Seixas
68-Luis dos Santos Gonçalves

1810

Right
65-Conceição Nova
66-Gerónimo Vitória
67-Jose Campos Lima
68-Jose Teles
69-D. Ana Maria Aquino
70-Manuel Jose da Silva Ribeiro
Left
71-Dionísio Antonio Verney
72-Jose Lima Viana
73-Ana Joaquina Salgado
74-Pedro Lourenço Seixas
75-Luis de Santa Maria de Sousa

1820

Right
67-Conceição Nova
68-D. Rosa Joana Vitória
69-Jose Campos Lima
70-Jose Teles
69-D. Anna Thomasia
70-Manuel Jose da Silva Ribeiro
Left
73-Dionísio Antonio Verney
74-Domingos alves de Mendonça
75-D. Perpétua Pereira Faria
76-Pedro Duarte da Silva
77-Jose Pereira de Almeida Silva

1831

Right
68-Conceicão Nova
70-Jose Campos Lima
71-Jose Teles
72-D. Anna Thomasia
73-Francisco Ferrary
Left
74-Dionísio Antonio Verney
75-Domingos Alves de Mendonça
76-D. Perpétua Pereira Faria
77-D. Maria Gertrudes Seixas
78-Jose Pereira de Almeida Silva

4.2 The reconstruction process in relation to key historical events

Historical events based on:
MARQUES, A. H. de Oliveira, História de Portugal, Vol II and III, Palas Editores, Lisboa 1984

A-Augusta Street, main street
S-Sapateiros Street, secondary street
C-Conceição Street, transverse street

					1756/63-Seven years war/Portugal is neutral
					1759-The Jesuits were expelled
1760					1760-Started the reconstruction process
A-0	S-0	C-0	0	0	0
					1762-Seven years war/Spain, France and Italy signed the "Pact of Family" (Bourbons)/Portugal refuses to sign and is invaded
1763					
A-18	S-0	C-3	21	+21	0
					1763-The peace treaty is signed
1769					
A-42	S-3	C-6	51	+30	+3
					1769-Public selling of unbuilt properties
					1771- Public selling of unbuilt properties
					1777/86-The Court moved to Queluz as a rejection of Pombal's Lisbon
1782					
A-51	S-11	C-10	72	+21	+8
1790					
A-51	S-16	C-11	78	+4	+5
					1790-War with Spain
					1791-The queen D. Maria I became mad
					1792-D. João became King and ruled the country with indecision and fear.
					1793-French corsairs attack Portuguese vessels.
					1795-The peace is signed with France
					1795/97-Spain and France prepare an invasion against Portugal
1801					
A-51	S-15	C-12	78	0	0
					1801-France and Spain declare war against Portugal. Portugal is the loser and has to pay a heavy compensation to Spain.
					1801/1807-Portugal becomes militarily and economically very dependent on Britain.
					1806-Portugal does not respect Napoleon's blockade to English ports. The Royal family took refuge in Brazil.
					1806-1st French invasion by Junot's troops
					1808-Wellington's troops defeat the French army
					1809-2nd French invasion

1810					
A-54	S-16	C-11	81	+3	0

1810-3rd French invasion
1815-Agriculture and commerce are in a deplorable situation.
1808/21-Brazil becomes a Kingdom of Portugal and Portugal with Beresford became an English protectorate.
1818/34-Liberal Revolution

1820					
A-55	S-16	C-11	82	+1	0

1821-During the absence of Beresford in Brazil a successful rebellion takes place. A council rules the country.
1822-Brazil becomes independent.
1823/40-Civil war between Liberals and Absolutists with the interference of Spain and France

1831					
A-55	S-16	C-11	82	0	0
1900					
A-63	S-	C-16			

4.3 References to the chronology of the reconstruction.

(13) França, José-Augusto,
"A reconstrução de Lisboa e a Arquitectura Pombalina", p.48 e 49, Biblioteca Breve, vol.12, 3ª edição, Instituto de Cultura e Língua Portuguesa, Ministério da Educação, Lisboa (1989).

"The evolution of works was irregular....."

"In 1765, there was no hurry to rebuild the city..... and in the centre there was much of debris of destroyed buildings.... just as followed 1755...."
J. Gorani (Portugal a corte e o pa´s nos anos de 1765 a 1767, trad. port, Lisboa 1945.
In 1766, "... it is possible just to see one house here and one there..."
"In 1771... Lisbon is in the same situation of destruction, but everyday a new building starts to be built..."

"In 1774, The destruction of the earthquake looks to be recent, most of the streets are in ruins..."
"In 1780 the progress of the reconstruction seemed to be slow..."
In 1780 "the rubbish looked to be the same as in the cursed year"
Madame Junot
In 1766 - there were 59 buildings on streets in the Pombaline area (31 in Augusta street); by 1776 there were 140.
Manuscrito de José Monteiro de Carvalho"Relação das propriedades.... edificadas ou reedificadas entre 1755 e 1778, Arquivo Municipal de Lisboa
1765-The east side of Rossio Square was built.
1840-Rossio was complete.
"The minister left more than half built"...
E. Freire de oliveira, Elementos para a Histório do Município de Lisboa, Vol i, Lisboa.

(1) França, José-Augusto,"Lisboa Pombalina e o Iluminismo", Bertrand Editora, Lisbon, (Dec. 1983).
"Immediately after the Marquis de Pombal´s death, in 1777, all public works were suspended..."

1776-"There were built 140 buildings"

"By 1766 there were 59 buildings, of which 31 were on Augusta Street."
1776-"There were approx. 200 buildings"

4.4 Completed buildings (by street) between 1766 and 1788 (After Luis Pastor de Macedo[32]).

Without any reference.

	1766	1760-88
Augusta Street	4	14
Prata Street	3	16
Fanqueiros Street	4	5
Sapateiros Street	0	5
Correeiros Street	3	5
Douradores Street	0	2
Comércio Street	8	15
S. Julião Street	0	14
Conceição Street	2	6
Augusta Street	19 (East) 12 (Weast)	22

4.5 Records of building contracts during the construction period

i) Source of references for the contracts

Contract n. 0

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, number 15, Junho de 1759, Arquivo Nacional da Torre do Tombo, Lisbon. Between Manuel de Sousa Alves Coutinho and the mason Mateus Luis.

Contract n. 1

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, number 4, Junho de 1759, Arquivo Nacional da Torre do Tombo, Lisbon. Between José Manuel da Fonseca and the mason Joaquim Madeira.

Contract n. 2

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 9, Caixa 2, number 87, Janeiro de 1761, Arquivo Nacional da Torre do Tombo, Lisbon. Between João Batista Terrabuse and Jacinto Pereira.

Contract n. 3

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares Carvalho, Cartório 4, Livro 18, Caixa 4, number 23, May 1766, Arquivo Nacional da Torre do Tombo, Lisbon. Between António Monteiro Godinho and Francisco José Fonseca da Silva

Contract n. 4

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, number 55, May 1776, Arquivo Nacional da Torre do Tombo, Lisbon. Between António de Melo and the mason Francisco Fernandes Bento.

Contract n. 5

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 49, Caixa 10, number 13, Abril de 1777, Arquivo Nacional da Torre do Tombo, Lisbon. Between António Pedro and the master Manuel dos Santos Torres.

Contract n. 6

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, number 91, Agosto de 1760, Arquivo Nacional da Torre do Tombo, Lisbon. Between João Batista Terrabufe and Jacinto Pires.

Contract n. 7

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 18, Caixa 4, number 26, Fevereiro 1766, Arquivo Nacional da Torre do Tombo, Lisbon. Between Francisco António Vieira and the mason Manuel Luís António Sousa

Contract n. 8

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 47, Caixa 5, number -, Agosto de 1766, Arquivo Nacional da Torre do Tombo, Lisbon. Between Cipriano Joaquim António and others.

Contract n. 9

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 34, Caixa 7, number 35, Março 1771, Arquivo Nacional da Torre do Tombo, Lisbon. Between Dom Henrique da Silva and others.

Contract n. 10

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 10, Caixa 2, number 74, Junho de 1761, Arquivo Nacional da Torre do Tombo, Lisbon. Between Francisco António Vasconcelos and Luis da Cunha e Castro.

Contract n. 11

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 3, Caixa 2, number 75, Maio de 1757, Arquivo Nacional da Torre do Tombo, Lisbon. Between Gaspar Teixeira and António Luís.

Contract n. 12

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, number 85, Maio de 1760, Arquivo Nacional da Torre do Tombo, Lisbon. Between Giraldo Roiz da Fonseca and Filipe Caetano.

ii) Resumé of significant aspects of the contracts.

a) Master mason acting as general contractor:

Master mason coordinating all works including those of mason, blacksmith, and carpenter. Contract n.1

Master coordinating all masonry and carpentry works. Contracts n. 0, 2, 3, 7, 8, 9 and 11

Offices of mason and carpenter completely separated Contract n.12

b) Payments:

All construction costs about 840 thousand Reis, to be paid on arrival of a ship. Contract n.1

All the money must be paid after all the work has been completed and carefully inspected and measured, any delay has a penalty of 5 %. Contract n.0

Consigned construction: The master builds the building and has the right to be the owner of one shop and one flat. The payment would be made with the rents of the other flats. The penalty was 5%. Contract n.5

Payments in two parts. Contract n.7

The cost will be presented at the end of the works and payment would be made with the rents from the flats and annual payments of 80 thousand Reis during the necessary period of time to pay the full amount. Contract n.3

If the owner disappears or the mason fails all respective belongings must be appropriated. Contract n.0

The payment would include a part of the wood from a dismantled ship (in a proportion of one to three) and eight years of rents. Contract n.4

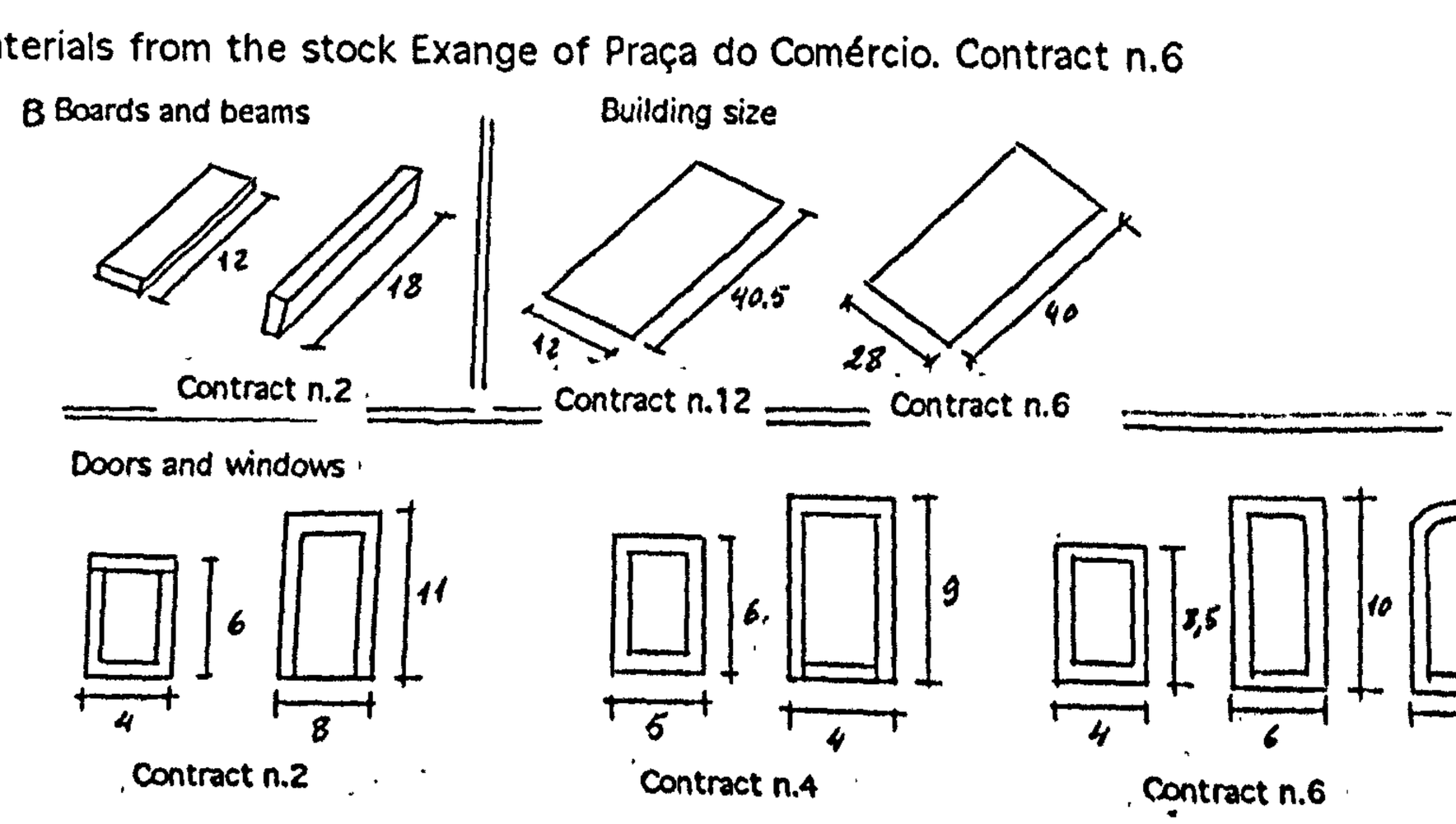
600 thousand Reis paid in advance. Contract n.7

All iron works must be paid for by the mason and the payment will be made with rents. 7.600 Reis during the present year, 160 thousands Reis at Christmas and 300 thousands Reis at the end of the works. Contract n.2

An amount of 760 thousand Reis must be paid with rents and tax. Contract n.11

c) Dimensions given in palms:

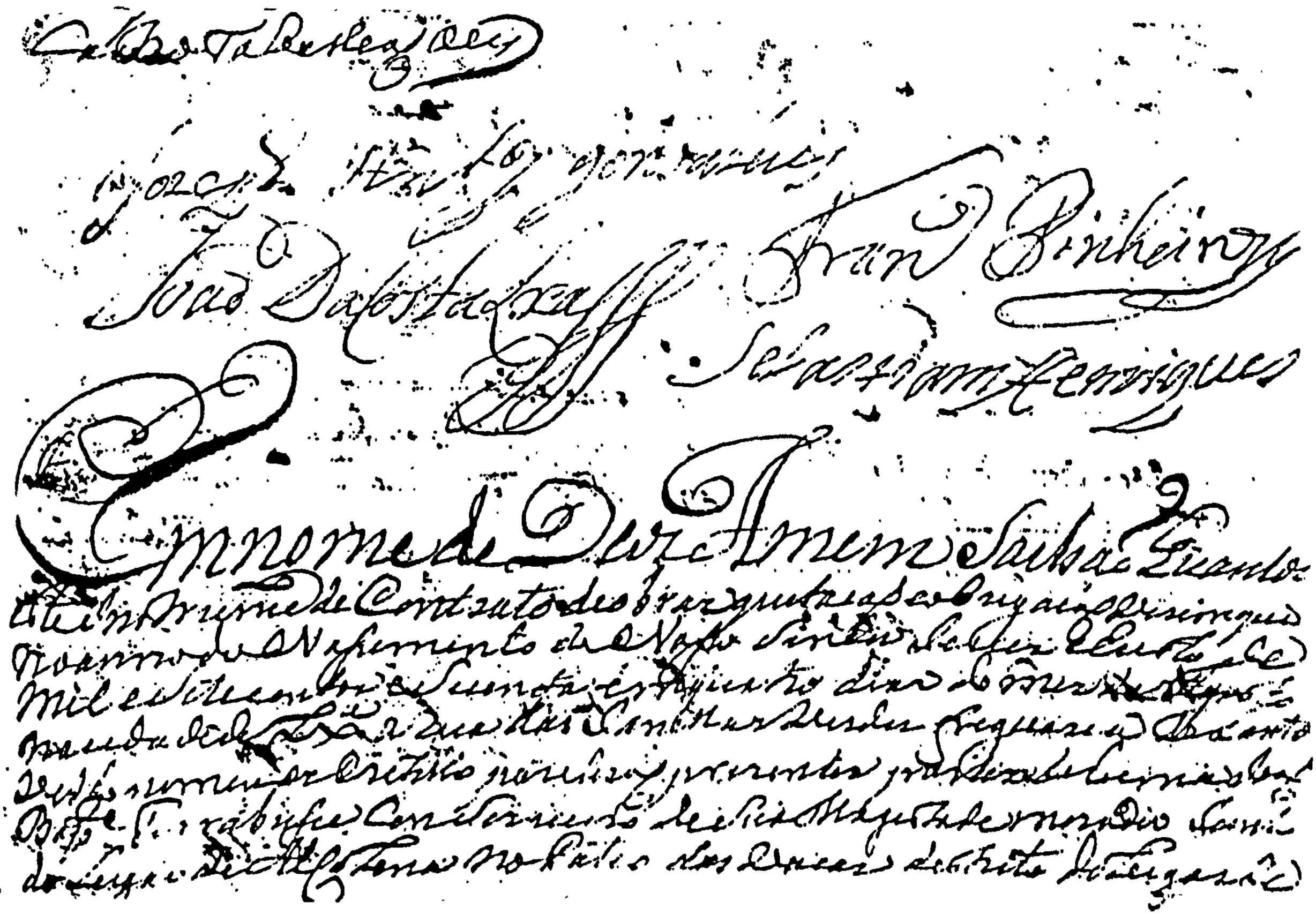
Materials from the stock Exange of Praça do Comércio. Contract n.6



iii)First example of a contract of 1760 and respective translation

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, number 91, Agosto de 1760, Arquivo Nacional da Torre do Tombo, Lisbon. Between João Batista Terrabufe and Jacinto Pires.

Copy of original



Translation

1760 Building Contract

From the Indice das Escrituras de Outobro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, no.91, Agosto de 1760, Arquivo Nacional da Torre do Tombo, Lisbon.

In the name of God, Amen. For knowledge of all this instrument of building contract the subscribers put themselves under obligation, on the 4th day of August in the year of our Lord Jesus Christ 1760, in the City of Lisbon, St Lourdes Street, parish of ... at my office being present, of the one part João Batista Terrabufe, conservator of Your Majesty, resident in Casas do Chito courtyard, in the place of Algolana of Belém, and the other Jacinto Peires, mason, living in front of Sapato Bay on the land side, it was agreed by me, notary and by the witnesses whose names are hereunder mentioned, that we subscribe the contract in which he, Jacinto Peires in a property of houses belonging to His Majesty, (on the land side), which is situated between the properties of the Marquis of Angoja to the North, measuring 28 palms and 40 palms at the bottom on which he intends to build shops and flats with hipped roofs, under which contract the master subscribes to build the aforementioned buildings on the following conditions, without any delay, undertaking the hallowed art of his office as mason as necessary, having in mind to return the buildings to João Batista strictly as follows: first, on the ground floor the shop is to have a door of six palms width and ten in height with an arch over, and another door to the stair of four palms width and 8.5 in height with an arch over, with a step and a window with a round arch of 6 palms width. On the first floor will be a french window of twelve palms height and 6 width, two

windows with half-circle arches with four panes one palm each wide and six in height. The stonework for the stairs must be from the stock exchange of the Terreiro do Paço, as the dormer windows must be from the Terreiro do Paço, with the exposed surfaces limewashed. The first floor beams must be squared, the thickest ones must be used for the attic. The other beams and the softwood for the floors must also be from the Terreiro do Paço, and the floor boards must be carefully planed on their faces, also the beams and boards used in the roof structure must be in softwood with the eaves of the roof to be *mouriscado*, with good tiles. All iron fixtures must be paid for by the builder with the exception of one item of ironwork which will be paid for by the owner because he intends it to be ornamental to his requirements. The same arrangement will apply to the materials for the fireplaces.

The wood used for floors and ceilings must be the same as that used for windows,and the same for the stairs. On this contract the owner must provide the necessary water.

The Contract Sum of 144 thousand Reis will be paid as follows:

In November the owner will finance a fund to be used during a calendar year.

One thousand Reis for the cost of the shops.

Sixty six thousand Reis on commencement of occupation of the flats.

The remainder of the 144 thousand Reis when the three flats have been completed.

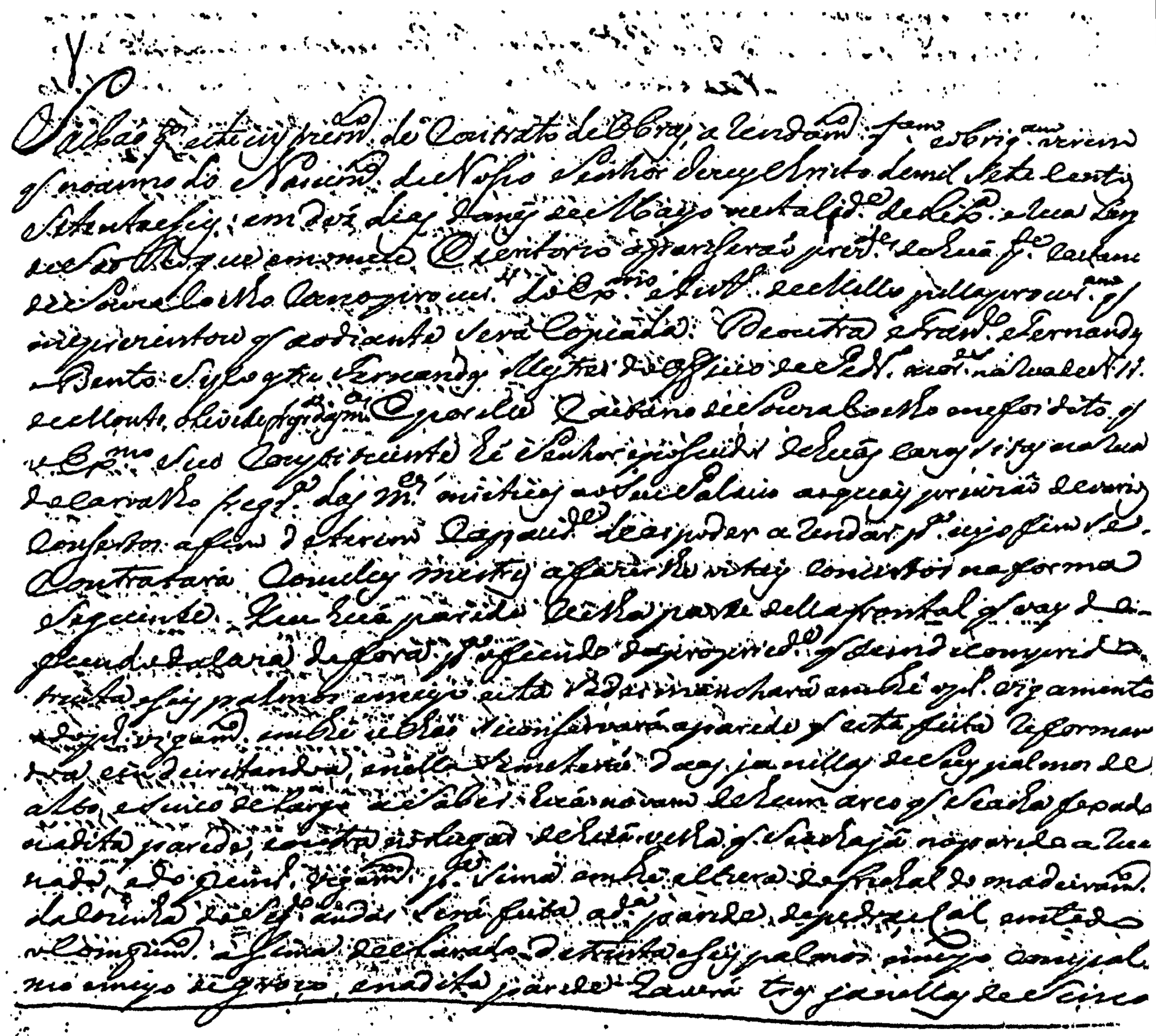
All the works including the finishing are included in the 144 thousand Reis and there shall be no departure from the contract sum after payment has been made.

All lime, stone, wood and iron fixtures will be included in the payments with the exception of the water. The total agreed payment as stated above will not be exceeded.

iv)Second example of a contract of 1776 and respective translation

Índice das Escrituras de Outubro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, number 55, May 1776, Arquivo Nacional da Torre do Tombo, Lisbon. Between António de Melo and the mason Francisco Fernandes Bento.

Copy of original



Translation

1776 Building Contract

From the Indice das Escrituras de Outobro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, No. 55, May 1776, Arquivo Nacional de Torre de Tombo, Lisbon.

To the knowledge of everyone obligated in this building contract, established on the second of May in the year of our Lord Jesus Christ 1776, in this city of Lisbon, in Broad Street of S. Roque, in my office were present his Excellency Caetano de Sousa Coelho as agent (attorney) of his Excellency Mr António de Melo, by the letter of attorney which was present and previously copied. Of the other part Francisco Fernandes Bento, Master Stonemason, who lives on Oliveira Hill Street, Parish ...

It was stated by Caetano de Sousa Coelho that his client is the owner of houses situated in Carvalho Street in the Parish of Merces adjoining his Palace, which need some repairs in order to be let. For this the stonemason, to make the essential repairs, was contracted as follows:

-The façade wall of the house belonging to the property which is 36.5 palms long, must be demolished, but the floor beams must be replaced and straightened. In the new wall there must be windows 6 palms high and 5 palms wide, taking advantage of the existing arch. Another window opening must be formed, facing the back yard.

-On the backyard elevation over the kitchen floor beams at second floor level, a wall must be built with stone and lime 36.5 palms long and 1/2palm thick to the height of the roof.

In this wall three window openings must be formed , 5 palms high and 4 palms wide, assembled on the *gaiola* of oak or Brazilian wood from dismantled ships.

The door garrison must be executed in Flanders wood and the panels in soft pine, following a simple pattern with the necessary ironmongery.

-In the case of the front façade the owner must provide all stone needed. The cost of bedding the stones is included in the contract which could compensate for the wood used for the *gaiola.* Also included is the cost of two glass windows in soft pine 5 palms high and 4 palms wide.

- The owner must provide all necessary masonry starting by the windows.

-The cost of daywork and the sand, lime and tiles (for the roof) needed to repair

the building is included in the cost of the contract, compensated if any wood is found which can be used in the building.

All wood found which is unsuitable for the repair work is for the builder in order to compensate for the work of dismantling ships in a proportion of one to three.

All rubble must be disposed of in the orange groves and vineyard behind the building.

The builder is to lower the roof structure of the second floor kitchen in order to connect it to the new wall throughout its length.

It is necessary to build an internal wall 12 palms long.

It is also necessary to extend the stone doorway at first floor level to a height of 9 palms, with a width of 4 palms, with a door made of wood of the same quality as the windows, namely soft pine, with good ironwork.

In all work the builders must follow the best traditions of their respective trades,

with all perfection, safety and commodity, beginning by depositing 1000 Reis without obligation.

Because the owner intends to rent the property to Dom João Ambrósio Bartolomeu, Venetian citizen for a period of eight years and ... months, starting on St John's day with the sum of 33,600 Reis paid or to pay between St John's day and Christmas, with the obligation to pay for the repair work, and also with the benefit of the other rents or sales, Dom João Ambrósio Bartolomeu is to pay the builder 120000 Reis. Under this contract 48000 Reis will be paid.

The owner solemnly undertakes to pay the remaining amounts as follows:

-12000 Reis when the work is finished.

-70000 Reis in three instalments

On 5th November this year

On 5th May 1777

On 5th November of the same year (1777)

If Dom João Ambrósio Bartolomeu does not keep his word, all the dwellings will be advertised for rent and he will forfeit all privileges, rights to charge rent and advance payments. To obtain the remaining amount all his properties and belongings

would be pledged.

Before the expiry of the agreed 8 year term of the lease the tenant may vacate the property if he can find another tenant willing to pay a higher rent, in which case the owner will receive this amount and pay it to the builder.During this period the tenant is not allowed to undertake any repairs until the total sum due has been paid. On expiry of the 8 year term a new rental contract will be established.

The builder undertakes to complete the works as soon as possible, before St John's day, forfeiting any interest or any increase above the agreed sum, and paying for any damage caused.

It is also necessary to form a window opening in the dining room 5 palms high and 4 palms wide, in the way described above for the other windows. The following are the names of the witnesses...

4.6 Letter from António Pardal Monteiro and respective translation

ANTÓNIO PARDAL MONTEIRO
ARQUITECTO

Caro colega

1 Realtivamente à questão que me põe, não tenho conhecimento de qualquer consulta feita por meu tio, o arq. Porfírio Pardal Monteiro.

2 O conhecimento da sua pessoa proveniente de laços familiares e, sobretudo, do facto de com ele ter trabalhado vários anos, levam-me a pensar que as afirmações por ele produzidas resultam de um conhecimento experimental das matérias em causa.

3 Com efeito, sei que se dedicou ao estudo pormenorizado da construção pombalina que lhe foi facilitado por intervenções que efectuou em edifícios da Baixa Pombalina.

4 Por outro lado, o contacto com gerações de canteiros (nas quais se incluia o seu próprio pai) que trabalharam no final do século XIX deve ter-lhe servido de fonte de informação, porquanto esses profissionais relatavam acontecimetos que os antecederam e que não me custa a crer que se relacionassem com o fornecimento de cantarias destinadas à reconstrução de Lisboa,

6 Eu próprio ouvi da boca de meu avô, entre outras, descrições pormenorizados relacionados com o transporte das colunas monolíticas destinadas ao Convento de Mafra, descrições essas que embora não coincidindo rigorosamente com o descrito por José Saramago no seu Memorial do Convento, na essência são plenamente concordantes. Ora, processando-se a reconstrução de Lisboa em data muito mais recente, não se me afigura inverosímil uma memória mais viva dos factos com ela relacionados,

7 Estas as razões que me levam a crer que, sem excluir a hipótese de consulta de documentação, esta não terá sido a sua principal fonte de informação e que se apoiou, sobretudo, na memória de gerações antecedentes e num exaustivo trabalho de análise dos edificios.

8 Ao seu dispor para o que lhe possa ser útil, apresento os meus cumprimentos.

Translation of letter from António Pardal Monteiro

'Dear Colleague,

Concerning your question, I do not know anything about any bibliographical research made by my uncle Porfirio Pardal Monteiro.

My knowledge about him comes from my family, and especially from the fact that he had worked with me for many years, which leads me to think that what he said is a result of experimental knowledge of the subject.

In fact, I know that he dedicated himself to the detailed study of Pombaline construction, which was readily done through the interventions he undertook in some of the buildings.

In another way, the contact with generations of stoneworkers (including his father, who worked at the end of the 19th century) could be his basis for the information, because these tradesmen recounted events from before their time, which could I believe be related to the supply of the masonry work for the reconstruction of Lisbon.

I have heard from my grandfather, among others, detailed descriptions related to the transportation of monolithic columns destined for the Convent of Mafra, which do not exactly coincide with those of José Saramago in his "Memorial of the Convent", but fully agree on the essential points. The reconstruction of Lisbon was undertaken later, so the memories of it are more alive.

Whilst not excluding the possibility of a documentary survey, these reasons lead me to believe that his main source of information could be the memories of previous generations and the exhaustive work of analysing buildings

Appendix 5 - A record of the plans of the Pombaline rentable buildings made by the author.

Appendix 5 presents the drawings of the internal plans of the buildings surveyed by the author. Each plan is numbered and the numbers correspond with the numbers on the blocks in Fig. 5.1 which is a general plan of the Pombaline area. It was not possible to survey all the buildings as some had been changed and access to some was prohibited. These are therefore left blank. A list of all the plans and their location is given on the following three pages. This survey is related to the first floor of the buildings.

All plans are to a scale of 1/400 with the exception of plans 2, 16 and 45 which are to a scale of 1/800.

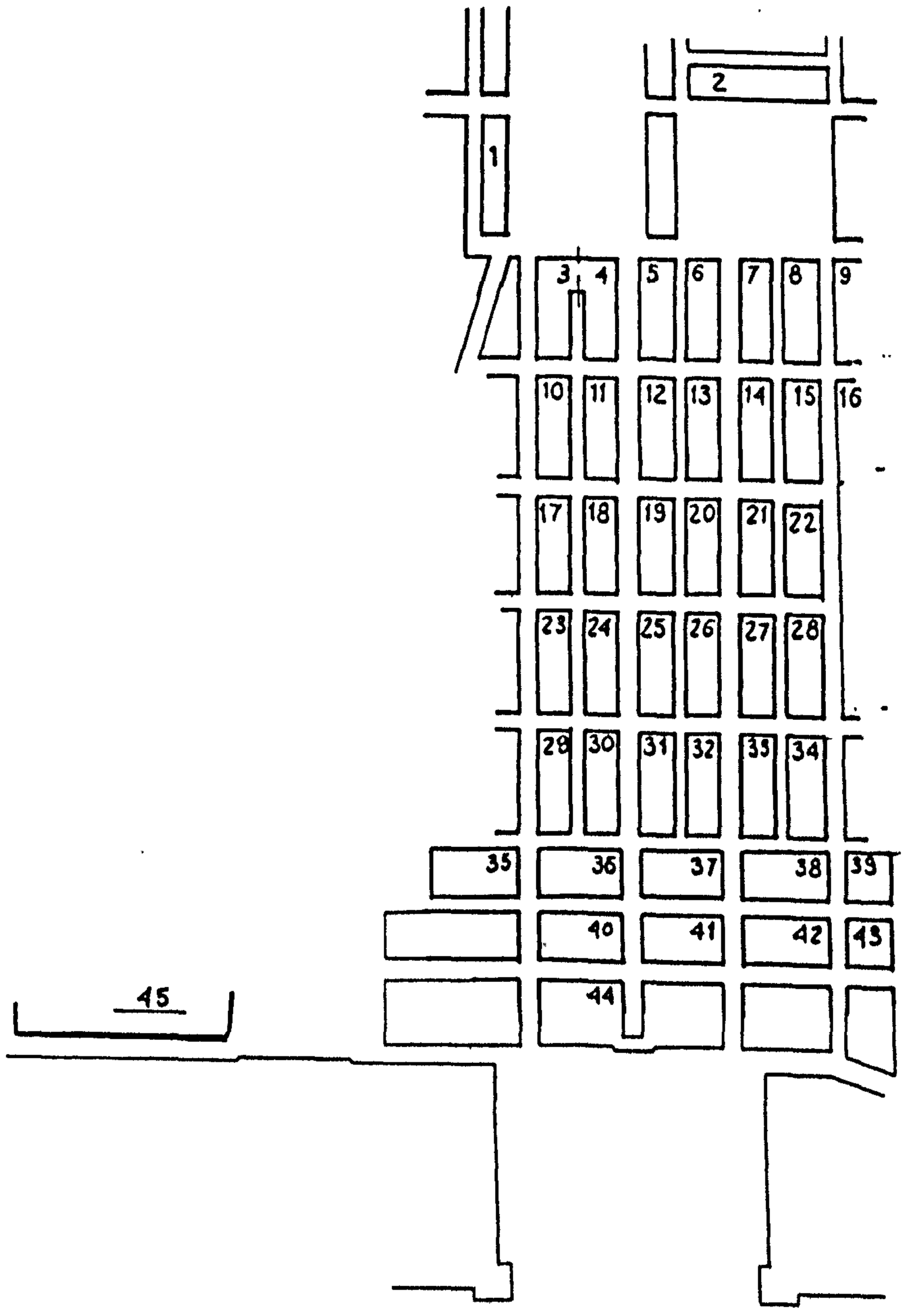


Fig.5.1 Plan of the blocks of Pombaline rentable buildings

List of plans

Plan 1 Block bounded by Calçada do Carmo, Primeiro de Dezembro Street, D. João da Câmara Square and Rossio Square.

Plan 2 Block bounded by D. Duarte Street, Igreja de S. Domingos Street, Amparo Street and Figueira Square.

Plan 3 Block bounded by Santa Justa Street, Ouro Street, Rossio Square and Sapateiros Street.

Plan 4 Block bounded by Santa Justa Street, Ouro Street, Rossio Square and Sapateiros Street.

Plan 5 Block bounded by Santa Justa Street, Augusta Street, Betesga Street and Correeiros Street

Plan 6 Block bounded by Santa Justa Street, Correeiros Street, Figueira Square and Prata Street.

Plan 7 Block bounded by Santa Justa Street, Prata Street, Figueira Square and Douradores Street.

Plan 8 Block bounded by Santa Justa Street, Douradores Street, Figueira Square and Fanqueiros Street.

Plan 9 Fanqueiros Street between numbers 320 and 274.

Plan 10 Block bounded by Assunção Street, Ouro Street, Santa Justa Street and Sapateiros Street.

Plan 11 Block bounded by Assunção Street, Sapateiros Street, Santa Justa Street and Augusta Street.

Plan 12 Block bounded by Assunção Street, Augusta Street, Santa Justa Street and Correeiros Street

Plan 13 Block bounded by Assunção Street, Correeiros Street, Santa Justa Street and Prata Street

Plan 14 Block bounded by Assunção Street, Prata Street, Santa Justa Street and Douradores Street

Plan 15 Block bounded by Assunção Street, Douradores Street, Santa Justa Street and Fanqueiros Street

Plan 16 Fanqueiros Street between numbers 268 and 78.

Plan 17 Block bounded by Vitória Street, Ouro Street, Assunção Street and Sapateiros Street

Plan 18 Block bounded by Vitória Street, Sapateiros Street, Assunção street and Augusta Street

Plan 19 Block bounded by Vitória Street, Augusta Street, Assunção Street and Correeiros Street.

Plan 20 Block bounded by Vitória Street, Correeiros Street, Assunção Street and Prata Street.

Plan 21 Block bounded by Vitória Street, Prata Street, Assunção Street and Douradores Street.

Plan 22 Block bounded by Vitória Street, Douradores Street, Assunção Street and Fanqueiros Street.

Plan 23 Block bounded by São Nicolau Street, Ouro Street, Vitória Street and Sapateiros Street

Plan 24 Block bounded by São Nicolau Street, Sapateiros Street, Vitória Street and Augusta Street

Plan 25 Block bounded by São Nicolau Street, Augusta Street, Vitória Street and Correeiros Street

Plan 26 Block bounded by São Nicolau Street, Correeiros Street, Vitória Street and Prata Street

Plan 27 Block bounded by São Nicolau Street, Prata Street, Vitória Street and Douradores Street

Plan 28 Block bounded by São Nicolau Street, Douradores Street, Vitória Street and Fanqueiros Street

Plan 29 Block bounded by Conceição Street, Ouro Street, São Nicolau Street and Sapateiros Street.

Plan 30 Block bounded by Conceição Street, Sapateiros Street, São Nicolau Street and Augusta Street

Plan 31 Block bounded by Conceição Street, Augusta Street, São Nicolau Street and Correeiros Street

Plan 32 Block bounded by Conceição Street, Correeiros Street, São Nicolau Street and Prata Street.

Plan 33 Block bounded by Conceição Street, Prata Street, São Nicolau Street and Douradores Street.

Plan 34 Block bounded by Conceição Street, Douradores Street, São Nicolau Street and Fanqueiros Street

Plan 35 Block bounded by Ouro Street, São Julião Street, Nova do Almada Street and Conceição Street.

Plan 36 Block bounded by Augusta Street, São Julião Street, Ouro Street and Conceição Street.

Plan 37 Block bounded by Prata Street, São Julião Street, Augusta Street and Conceição Street.

Plan 38 Block bounded by Fanqueiros Street, São Julião Street, Prata Street and Conceição Street.

Plan 39 Block bounded by Fanqueiros Street, São Julião Street, Madalena Street and Conceição Street.

Plan 40 Block bounded by Augusta Street, Comércio Street, Ouro Street and São Julião Street.

Plan 41 Block bounded by Prata Street, Comércio Street, Augusta Street and São Julião Street.

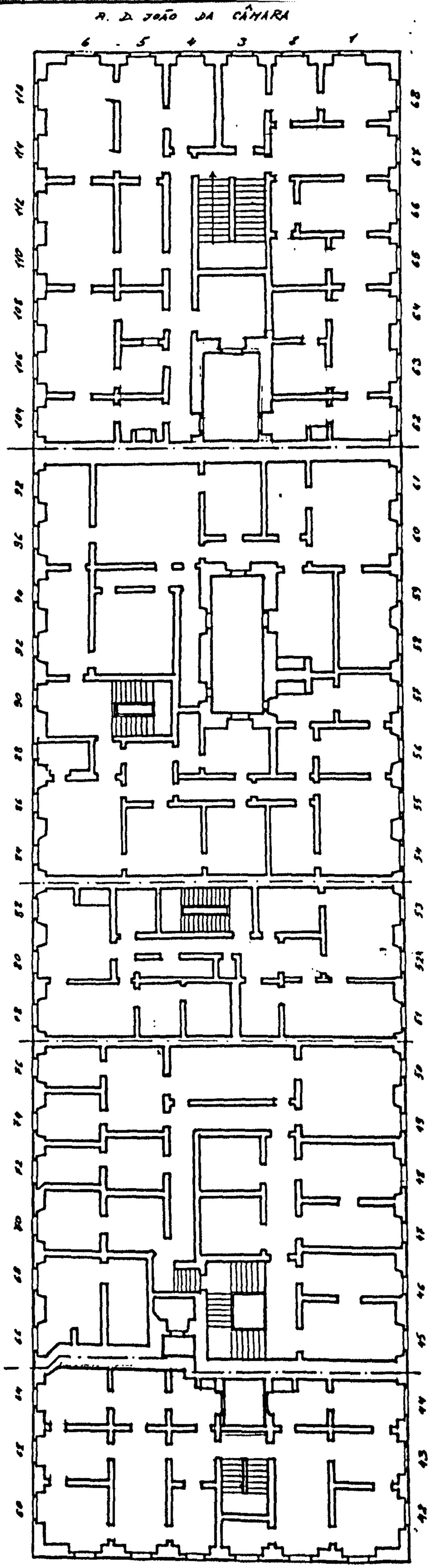
Plan 42 Block bounded by Fanqueiros Street, Comércio Street, Prata Street and São Julião Street.

Plan 43 Block bounded by Fanqueiros Street, Comércio Street, Madalena Street and São Julião Street.

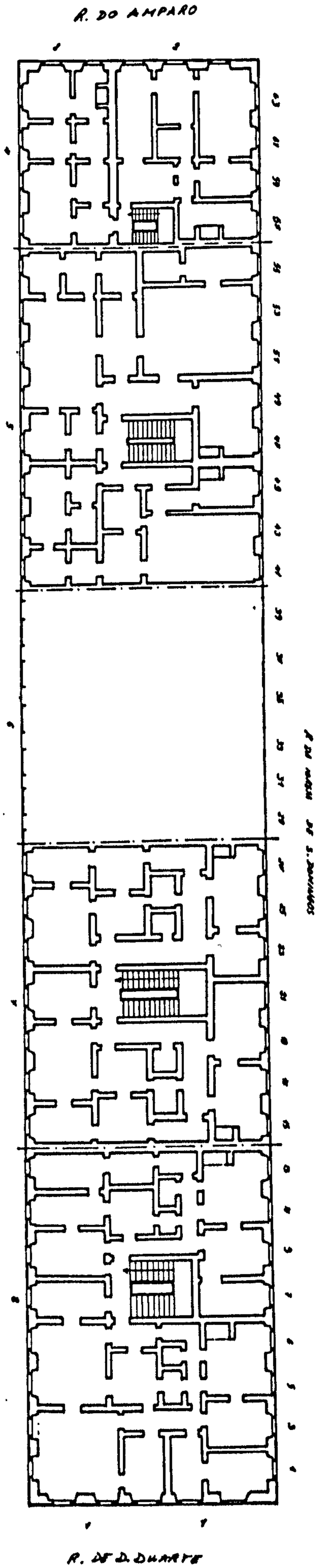
Plan 44 Comércio Street between numbers 85 and 109.

Plan 45 Arsenal Street between numbers 44 and 172.

Plan 1



Plan 2



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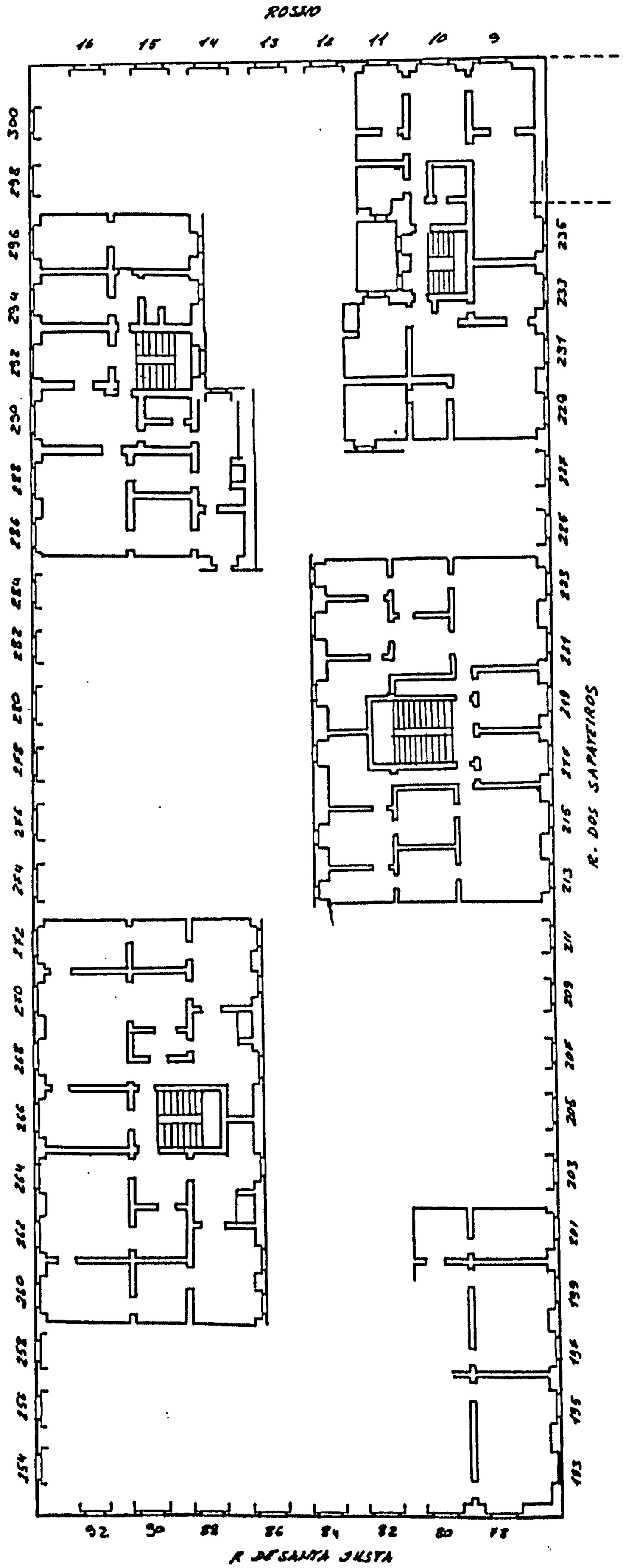
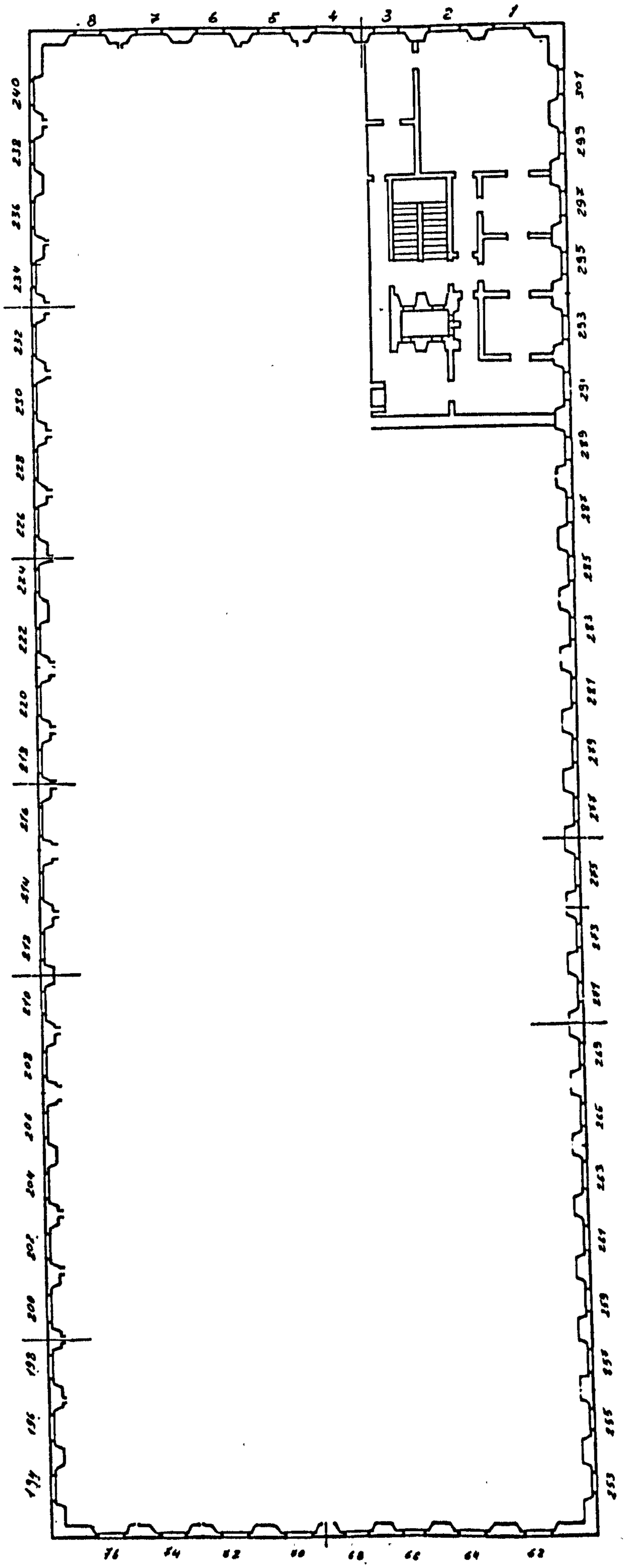
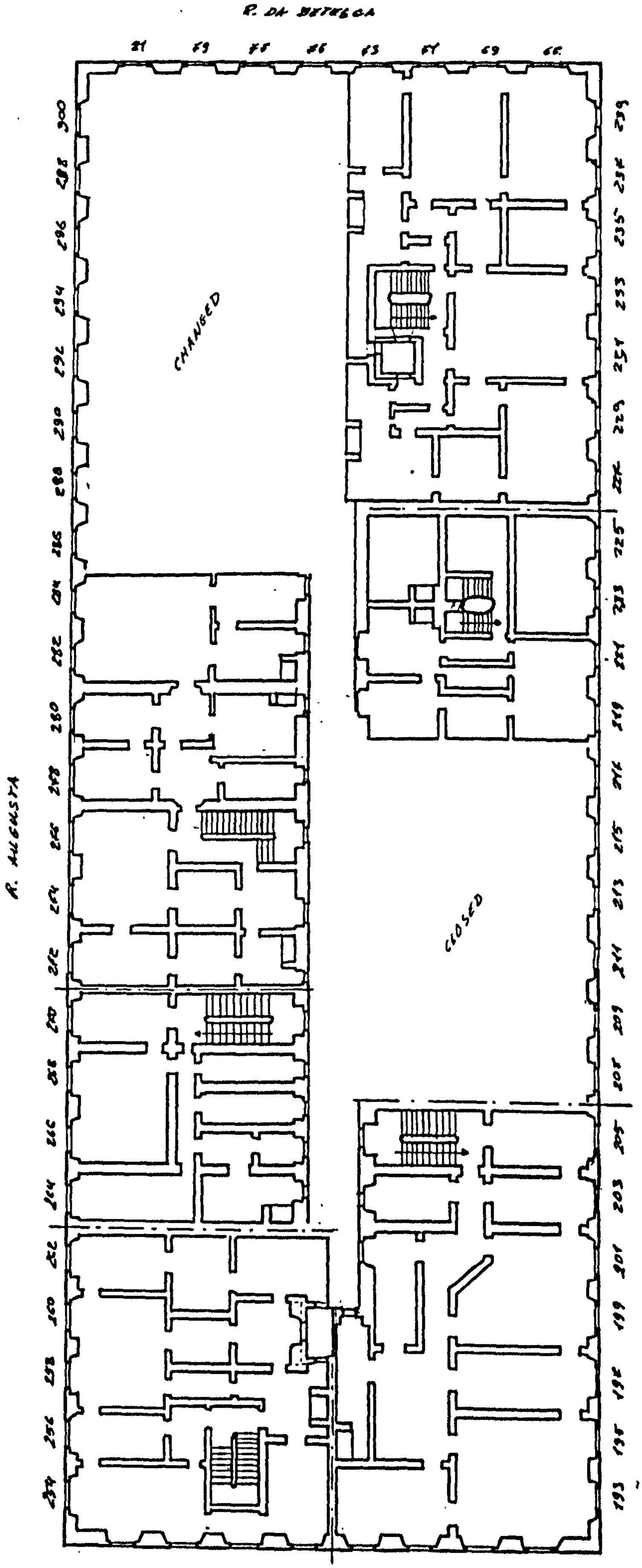

ROSSIO
16 15 14 13 12 11 10 9
300 298 296 294 292 290 288 286 284 282 280 278
235 233 231 229 227 225 223 221 219 217 215 213 211 209 207 205 203 201 199 197 195 193
R. DO OURO
R. DOS SAPATEIROS
276 274 272 270 268 266 264 262 260 258 256 254
92 90 88 86 84 82 80 78
R. DE SANTA JUSTA

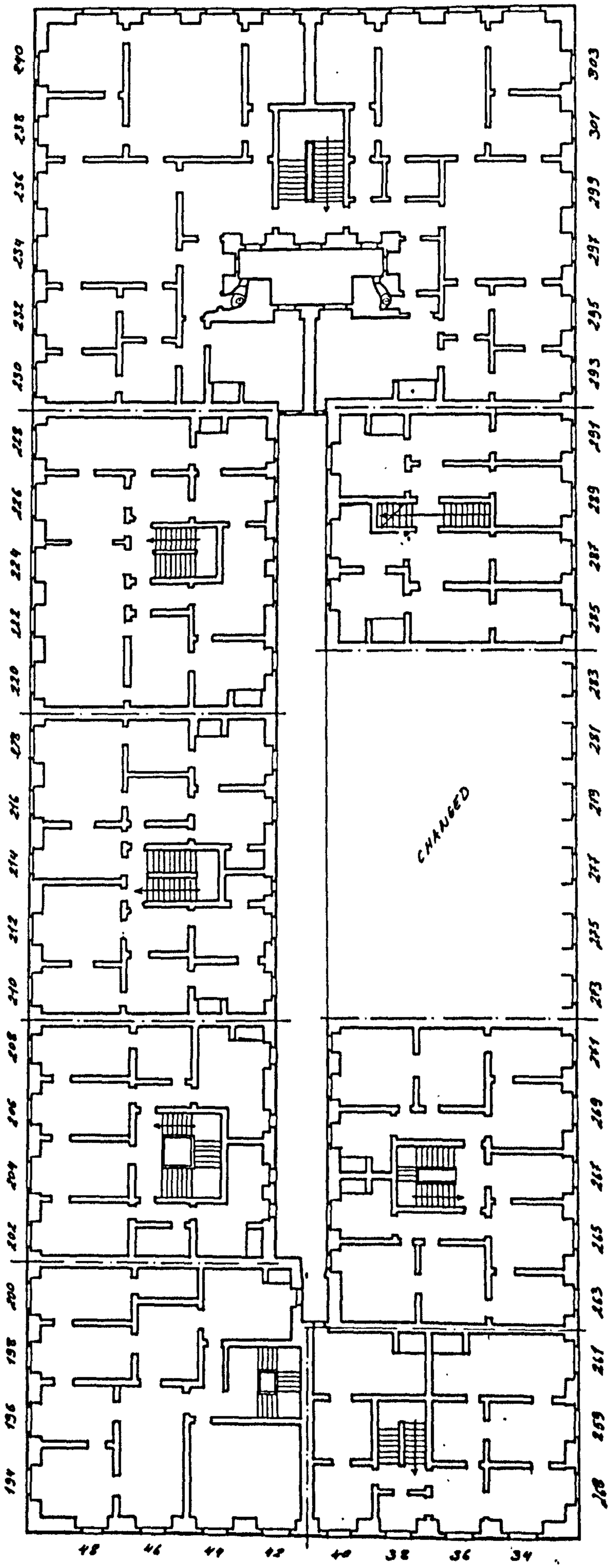
Plan 4



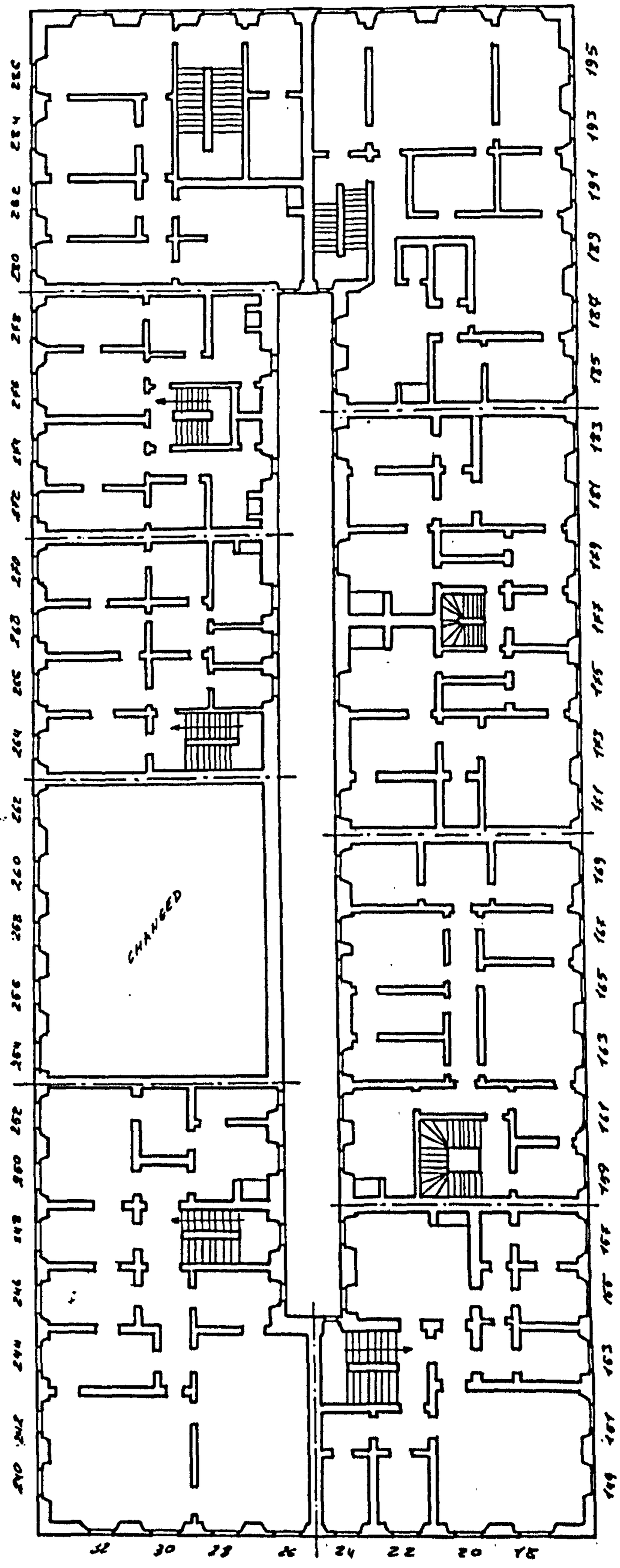
Plan 5


R. DA BETESGA
CHANGED
R. AUGUSTA
CLOSED
R. DOS CORREIROS
R. DE STA JUSTA

Plan 6


PRAÇA DA FIGUEIRA
R. DOS CORREEIROS
CHAUSSEE
R. DA PRAIA
R. DE STA JUSTA

Plan 7



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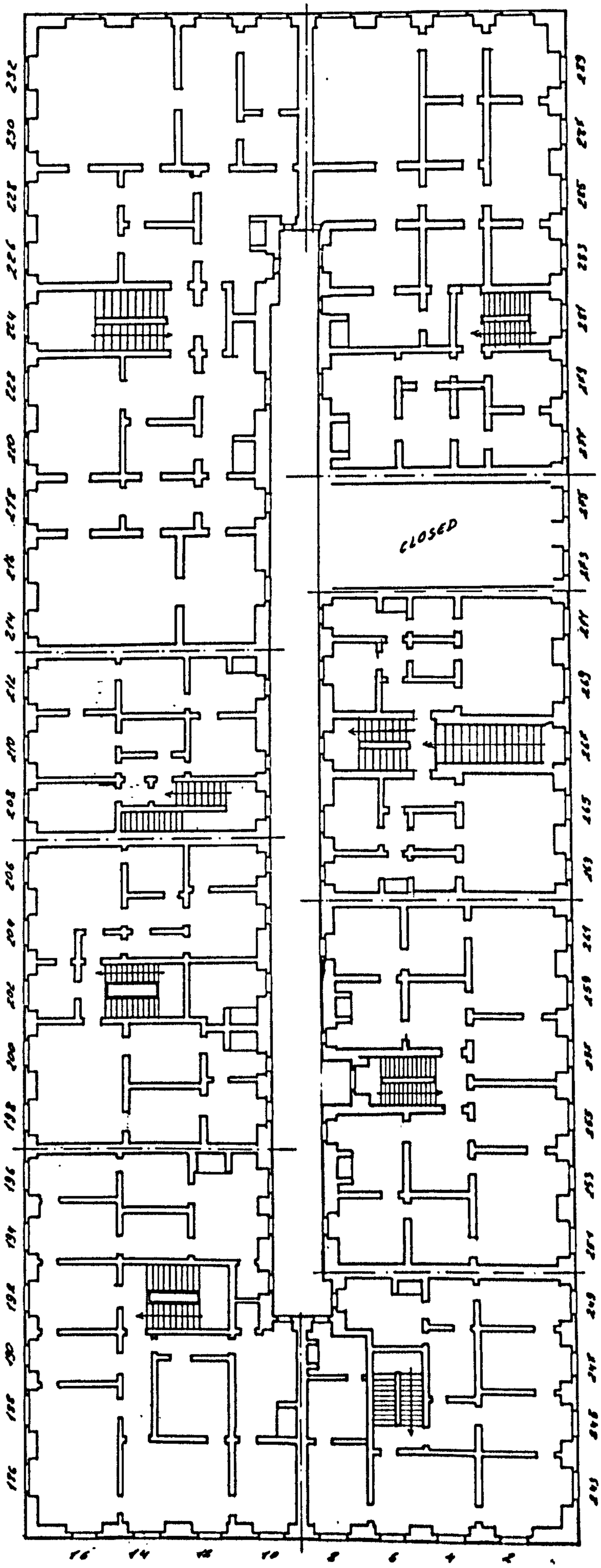
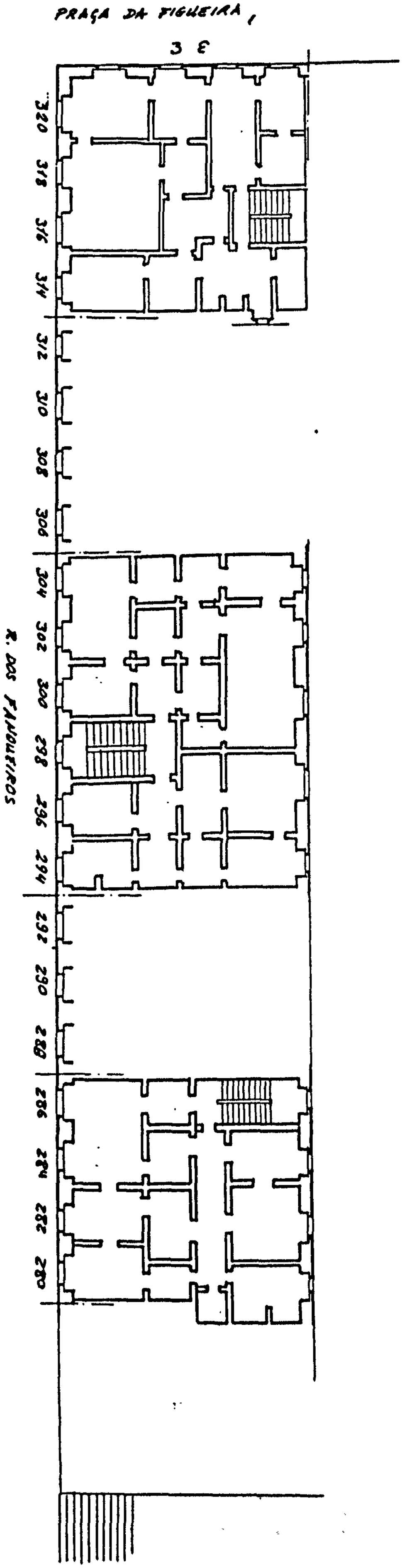

PRAÇA DA FIGUEIRA
CLOSED
R. DOS SAPATEIROS
R. DOS DOURADORES
R. DE S.TA JUSTA

Plan 9



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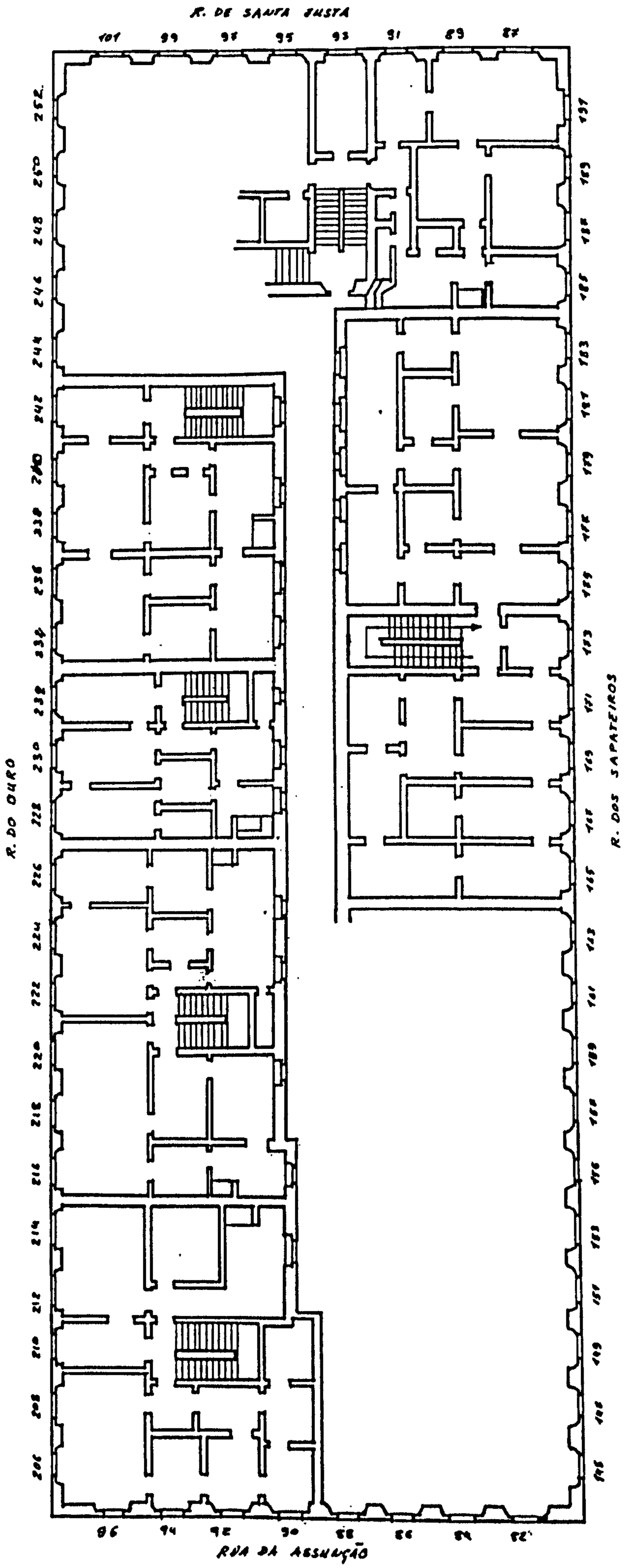

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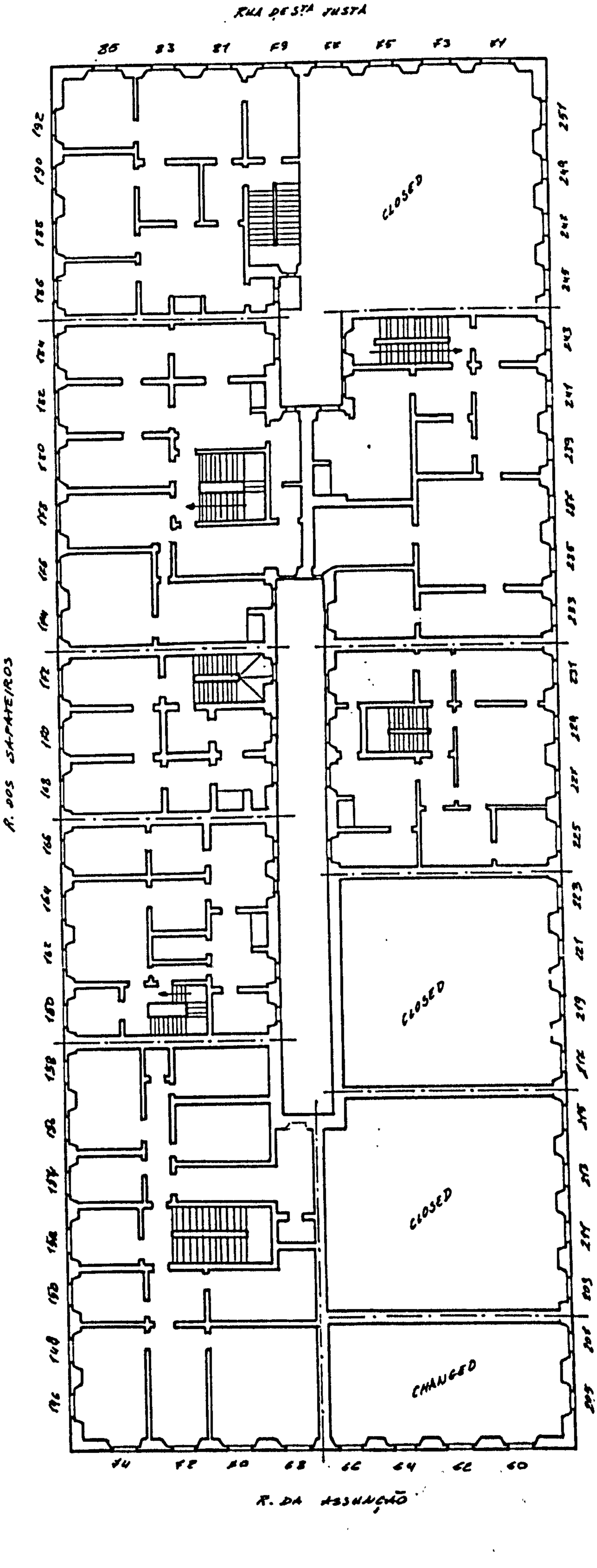
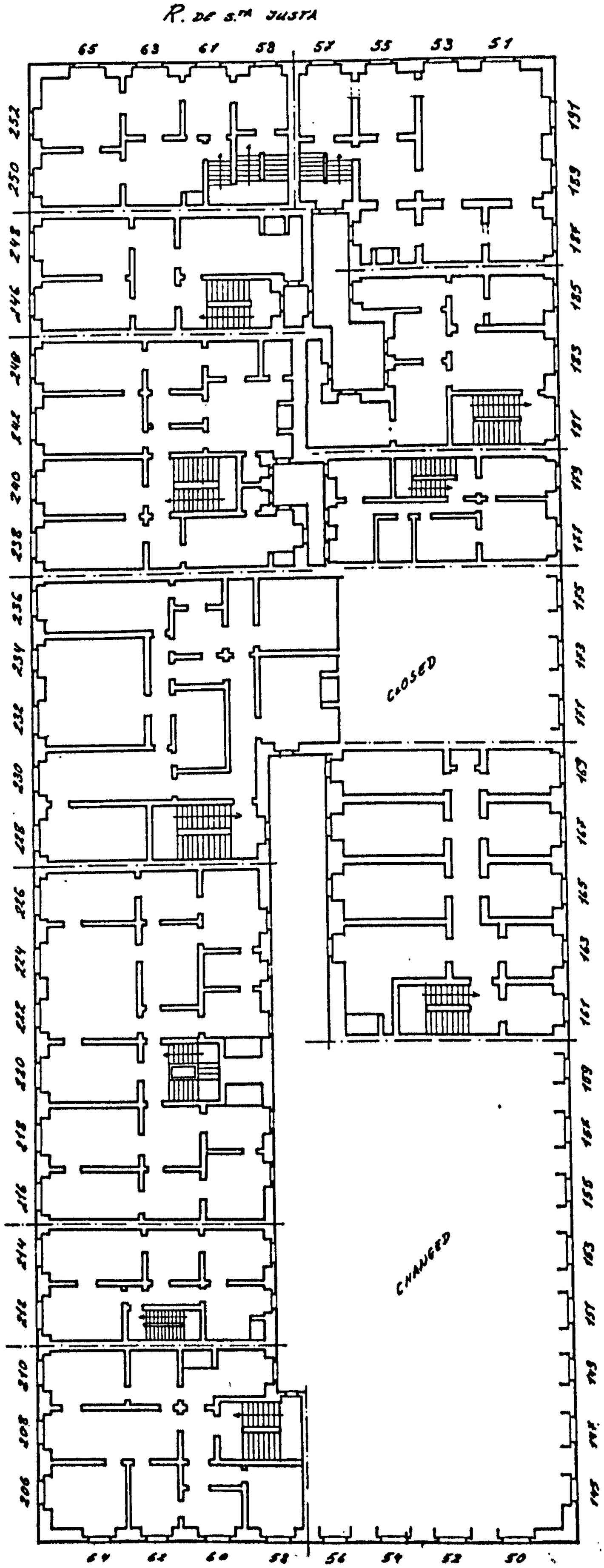

R. DA ASSUNÇÃO
R. DOS SAPATEIROS
R. AUGUSTA
CLOSED
CLOSED
CLOSED
CLOSED
CHANGED

Plan 12


R. DE S.TA JUSTA
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191 189 187 185 183 181 179 177 175 173 171 169 167 165 163 161 159 157 155 153
CLOSED
CHANGED
R. AUGUSTA
R. DOS CORREEIROS
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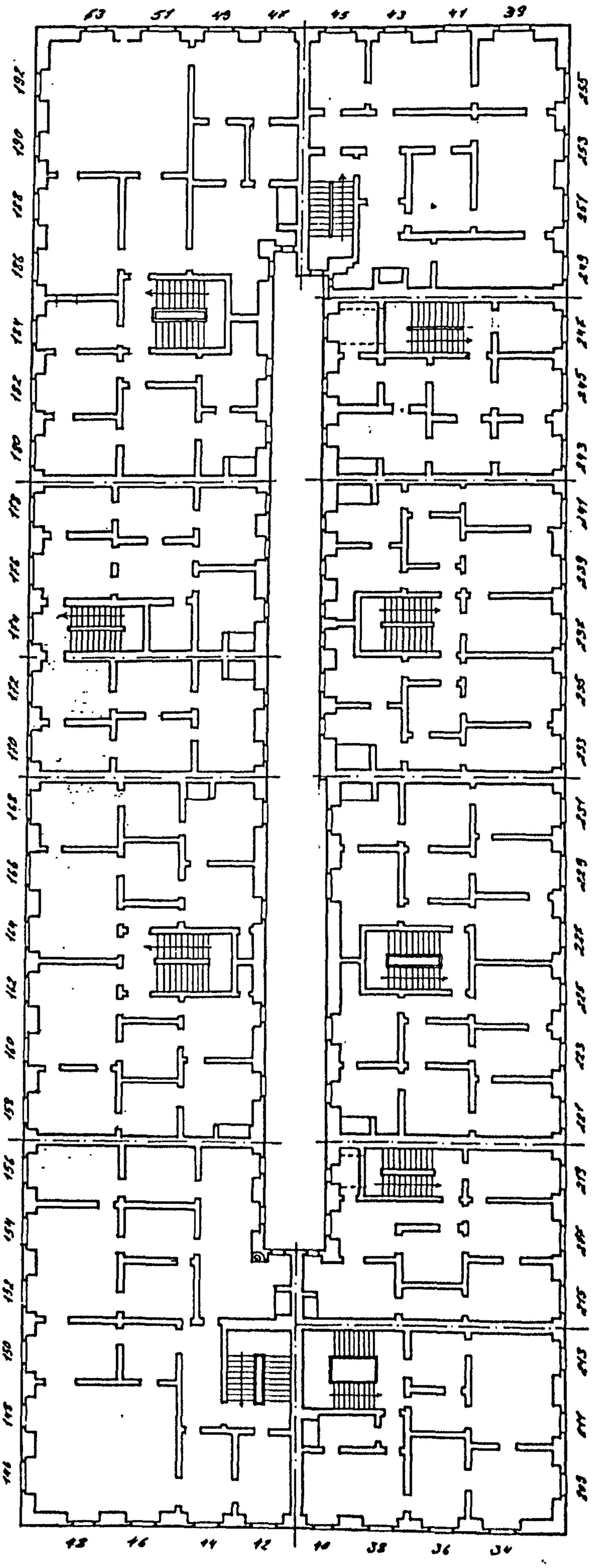
R. DA ASSUNÇÃO

Plan 13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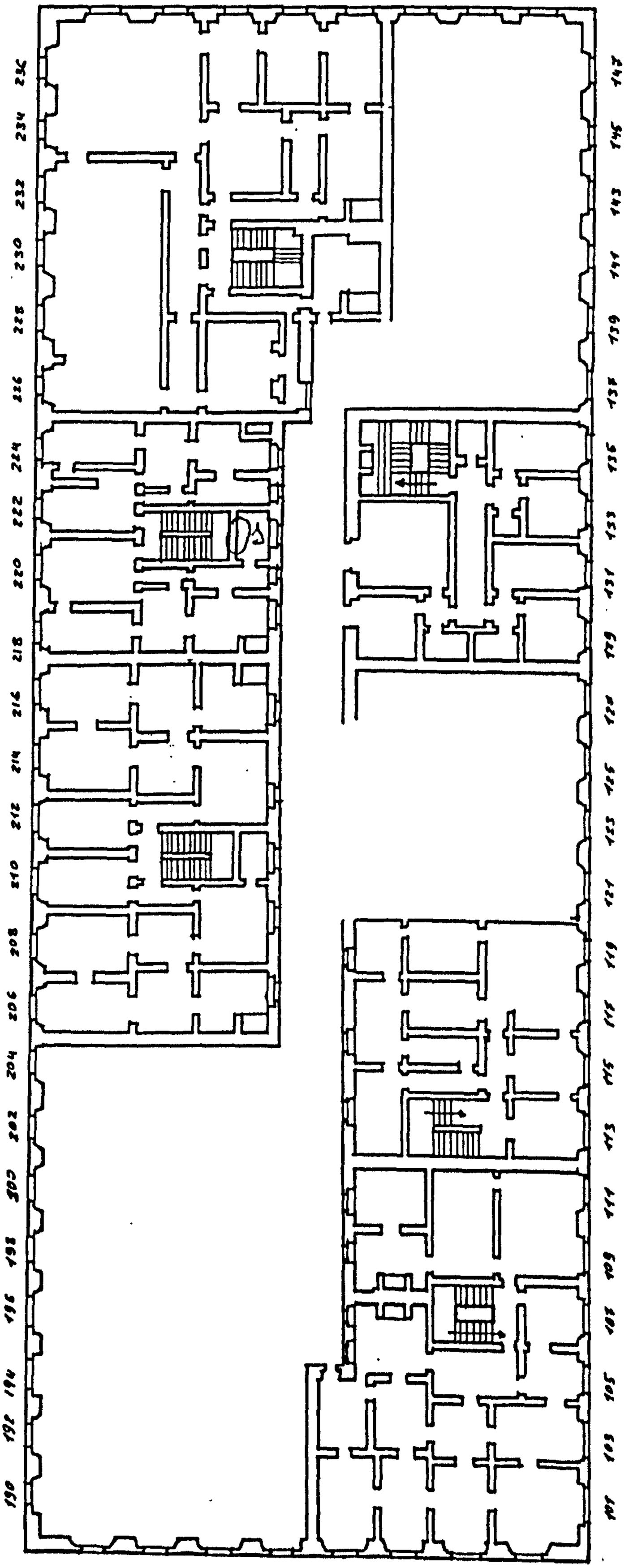
195 193 191 189 187 185 183 181 179 177 175 173 171 169 167 165 163 161 159 157 155 153 151 149 147
R. DOS CORREEIROS
R. DA PRAIA
R. DA ASSUNÇÃO
48 46 44 42 40 38 36 34

Plan 14



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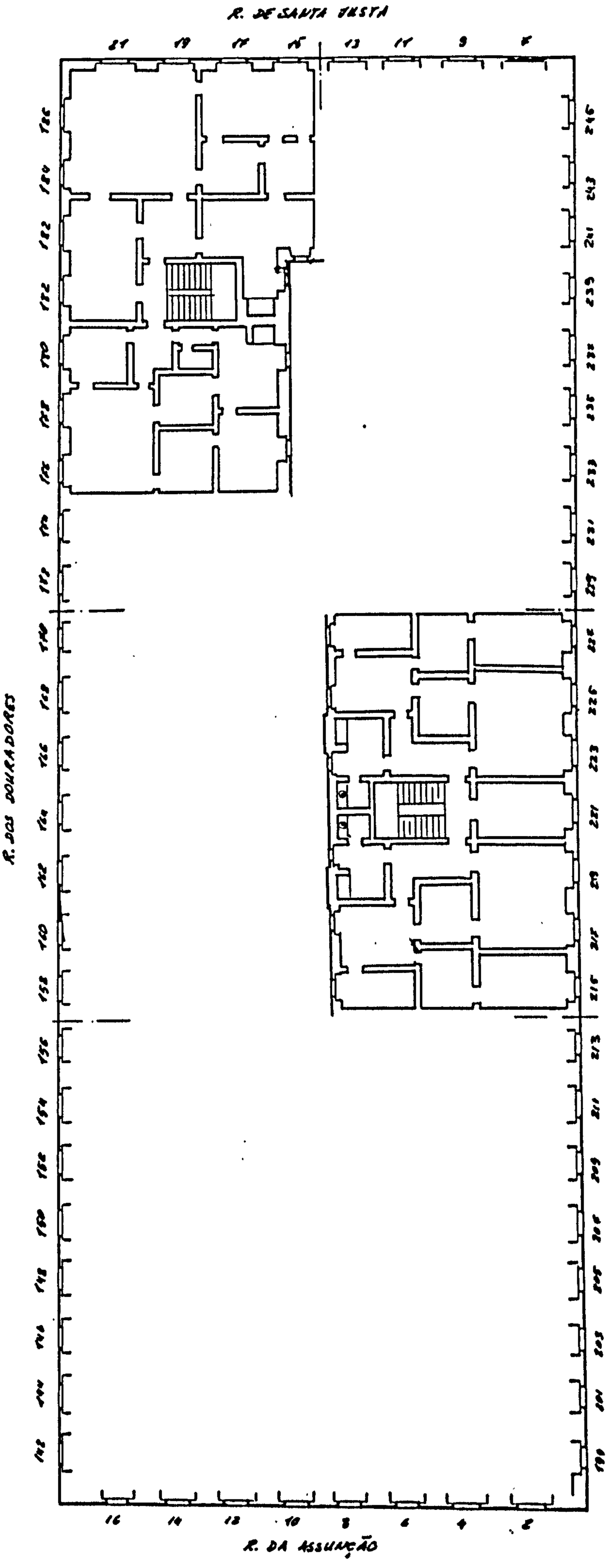
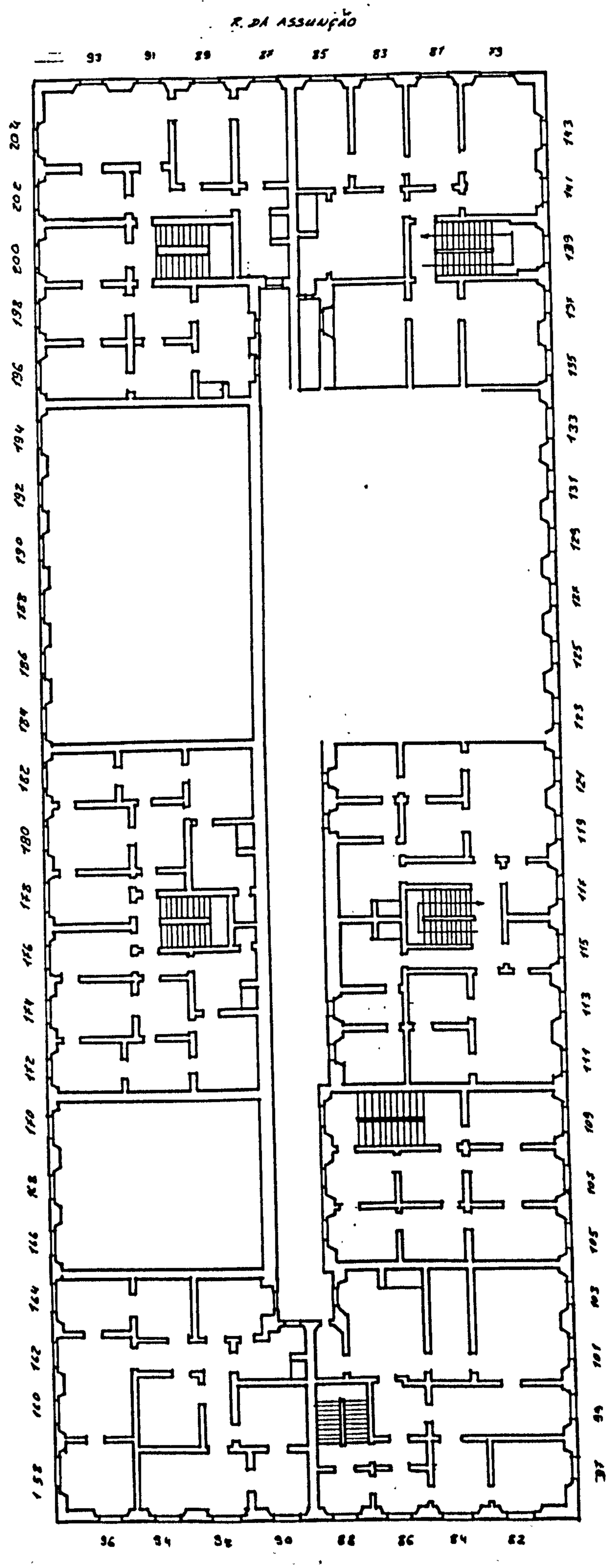

R. DE SANTA JUSTA
R. DOS DOURADORES
R. DOS PRATEIROS
R. DA ASSUNÇÃO

Plan 16

Plan 17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166 164 162 160
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133 131 129 127 125 123 121 119 117
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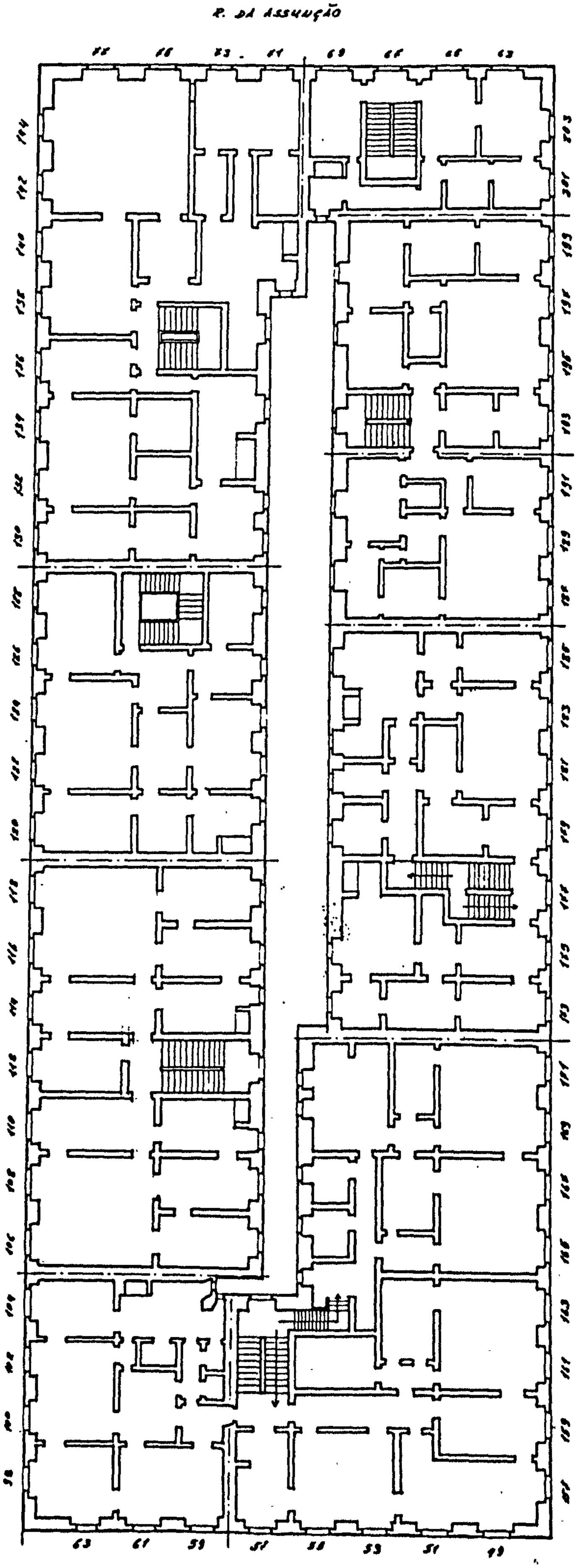
R. DO OURO
R. DOS SAPATEIROS
96 94 92 90 88 86 84 82
R. DA VITÓRIA

Plan 18



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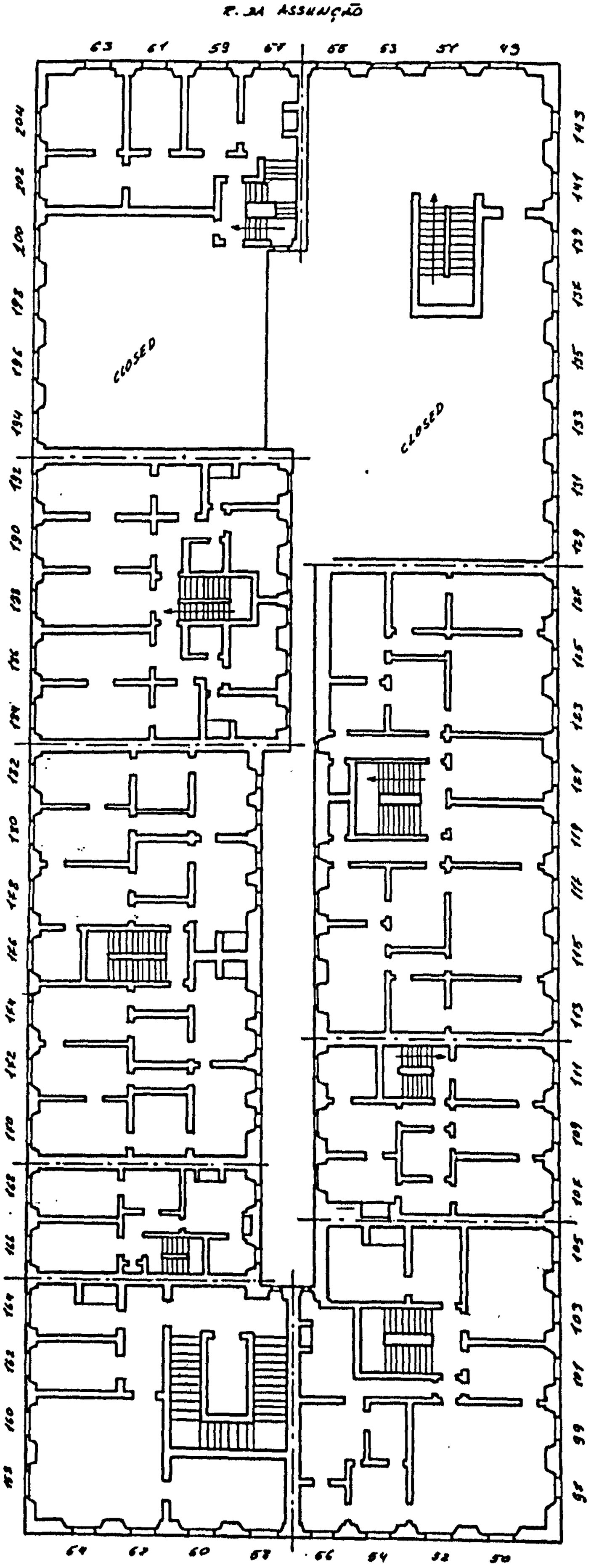
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CLOSED
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R. DOS CORREIROS
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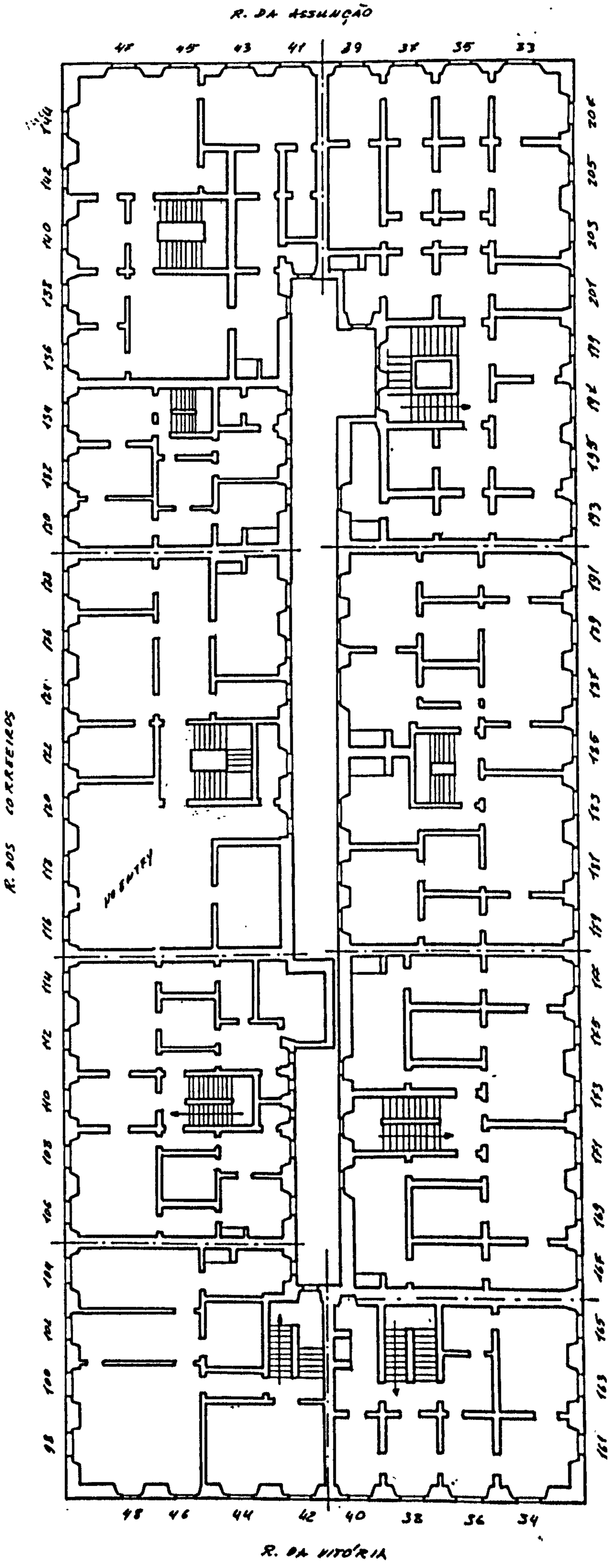
R. DA VITÓRIA

Plan 20



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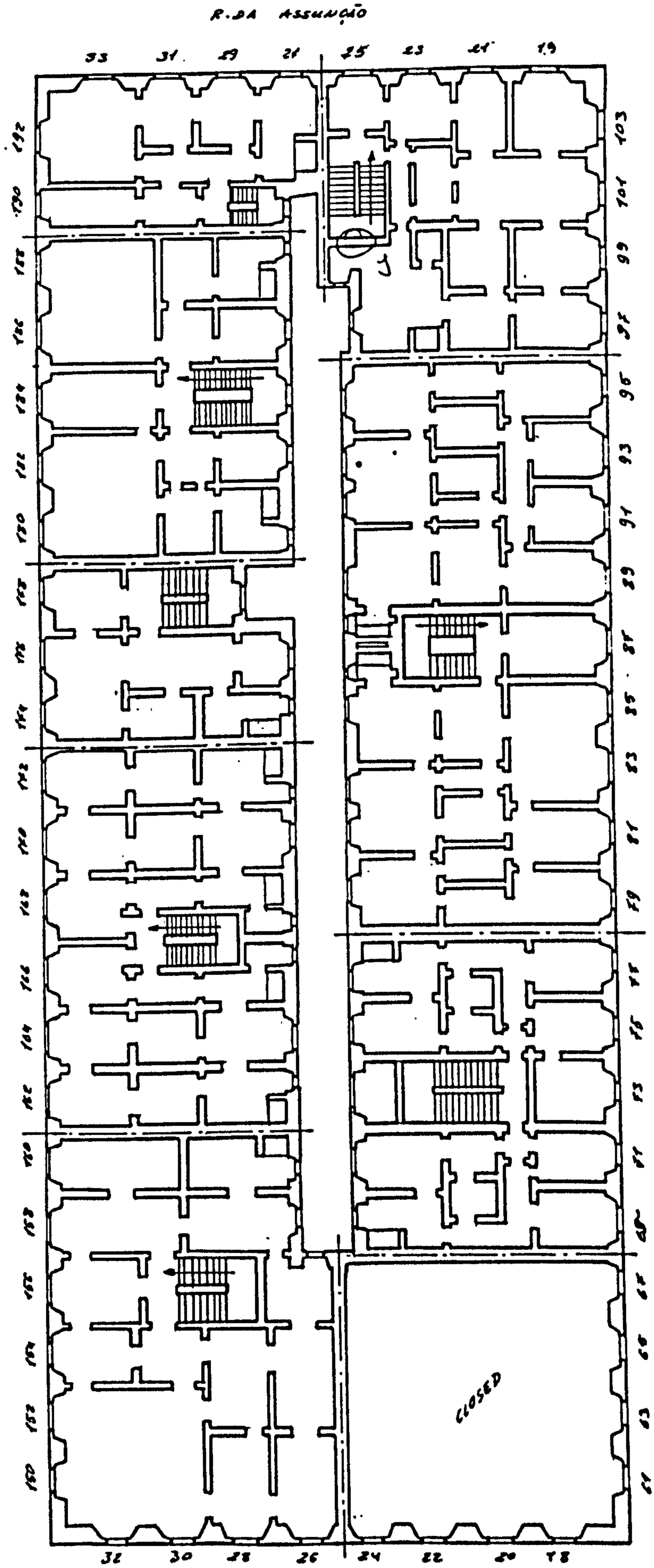

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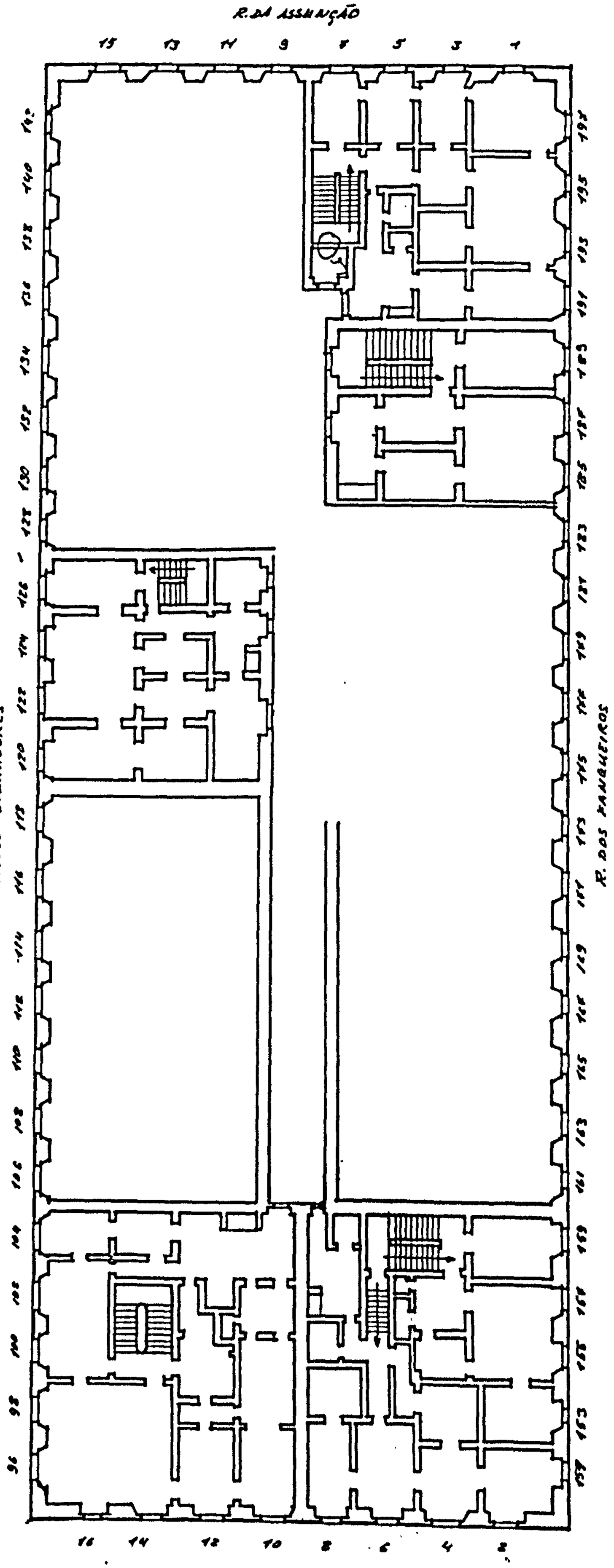

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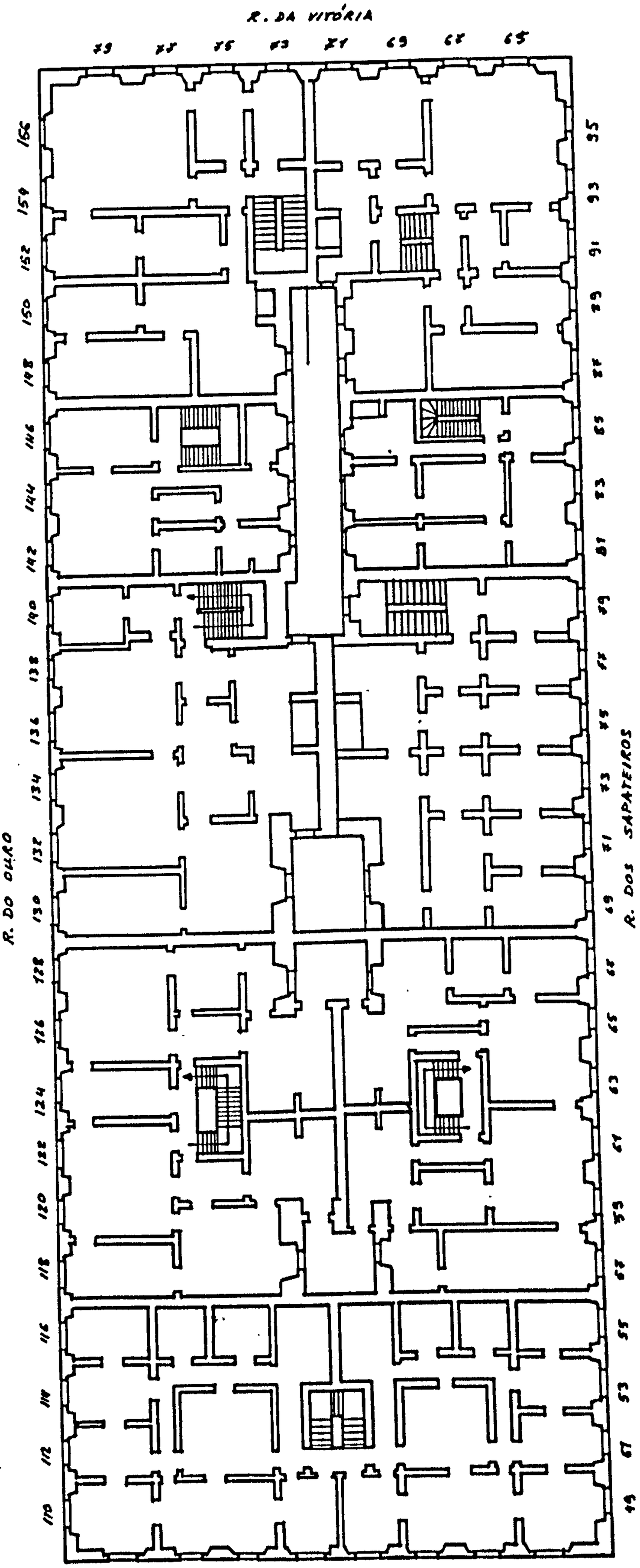

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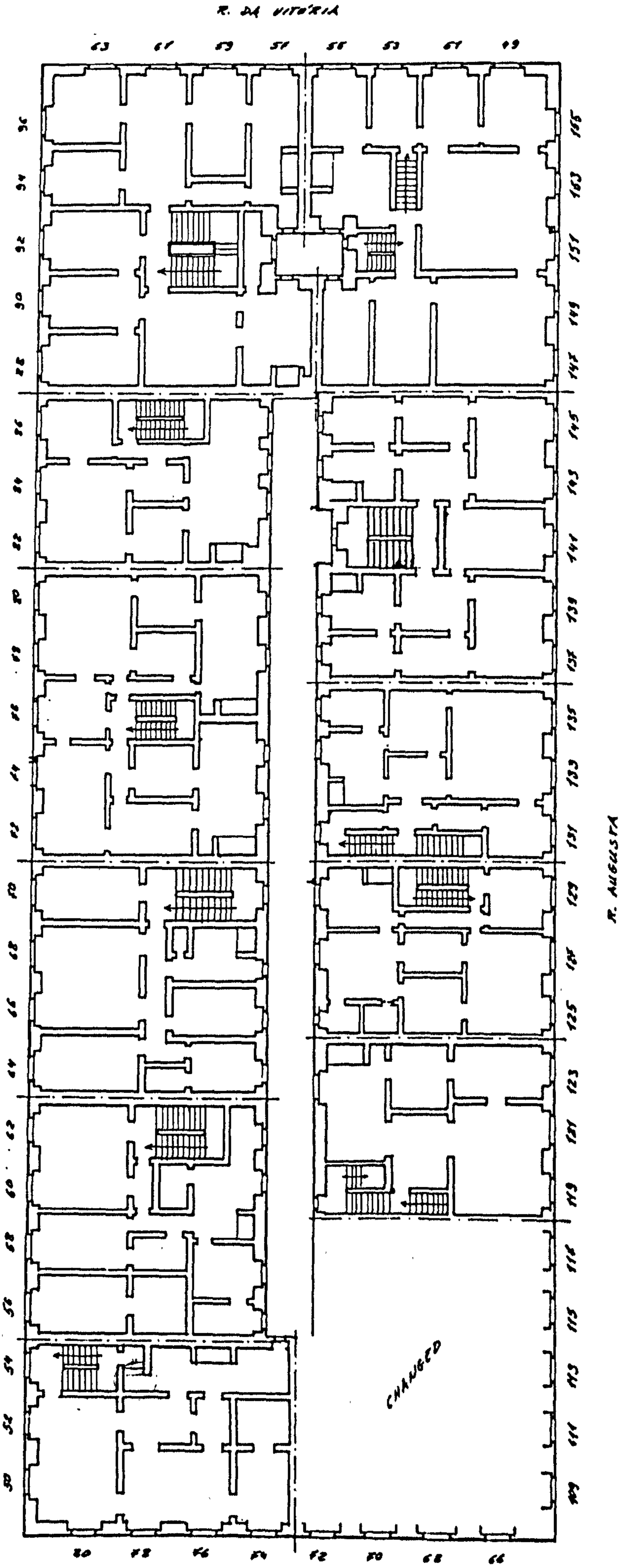
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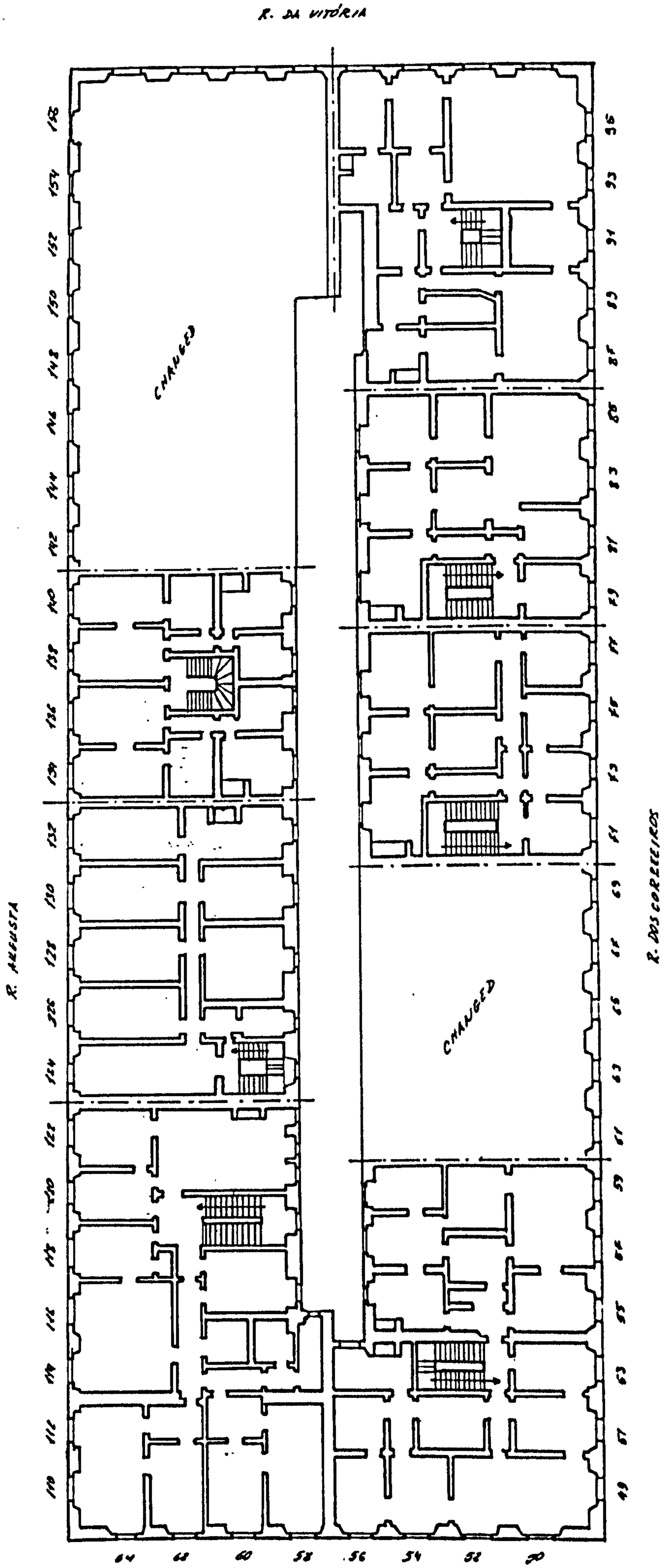
R. DOS SAPATEIROS
R. AUGUSTA
CHANGED
80 78 76 74 72 70 68 66
R. DE S. NICOLAU

Plan 25


R. DA VITÓRIA
R. AUGUSTA
R. DOS CORREEIROS
R. DE S. NICOLAU
CHANGED
CHANGED
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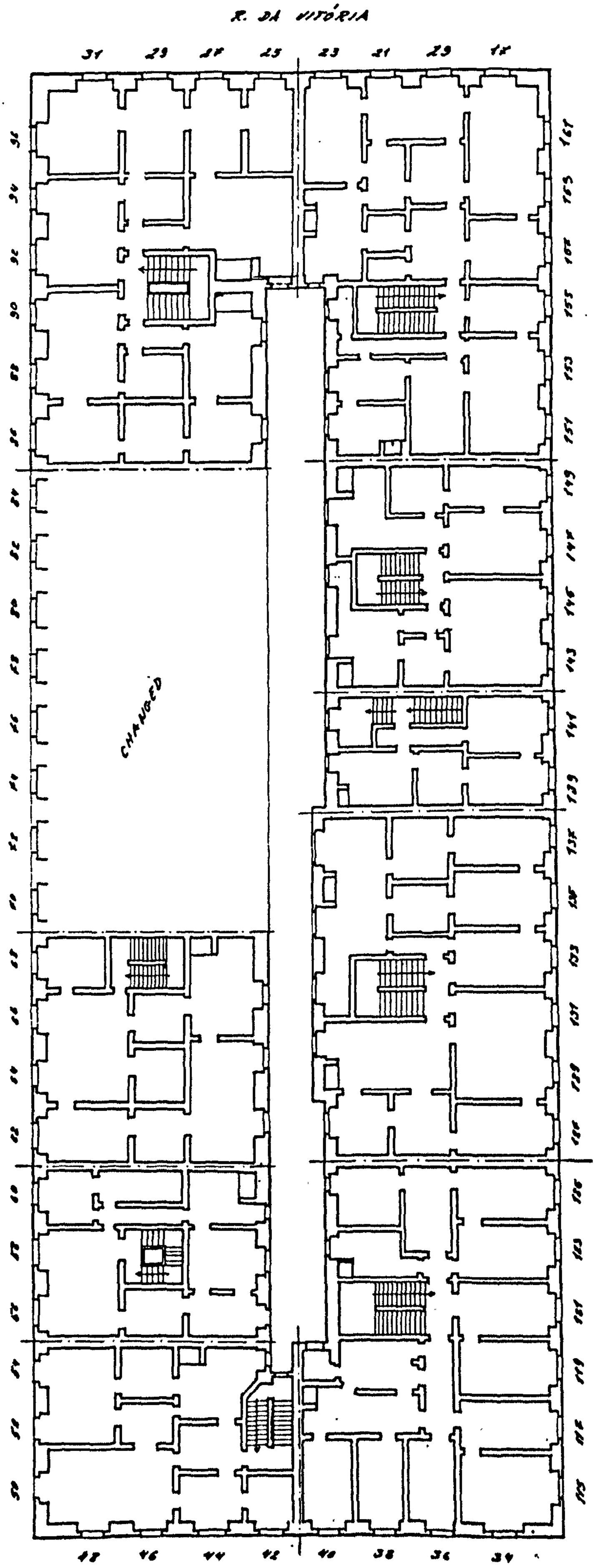
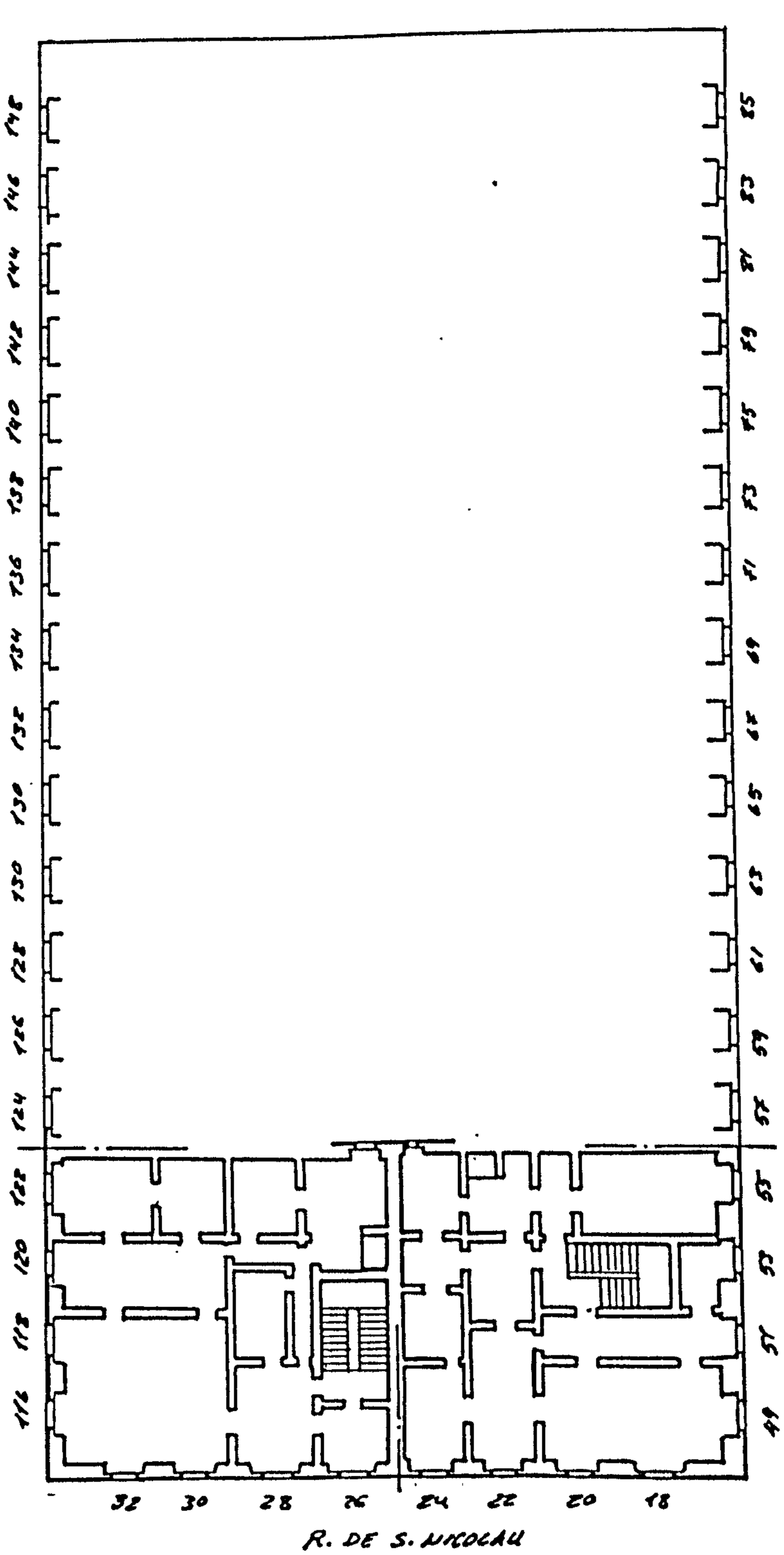
Plan 26


R. DA HISTÓRIA
R. DOS CORREEIROS
R. DA PRAIA
R. DE S. NICOLAU
CHANGED

Plan 27


R. DA VITÓRIA
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R. DA PRAIA
124 126 128 130 132 134
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R. DOS OURIVES
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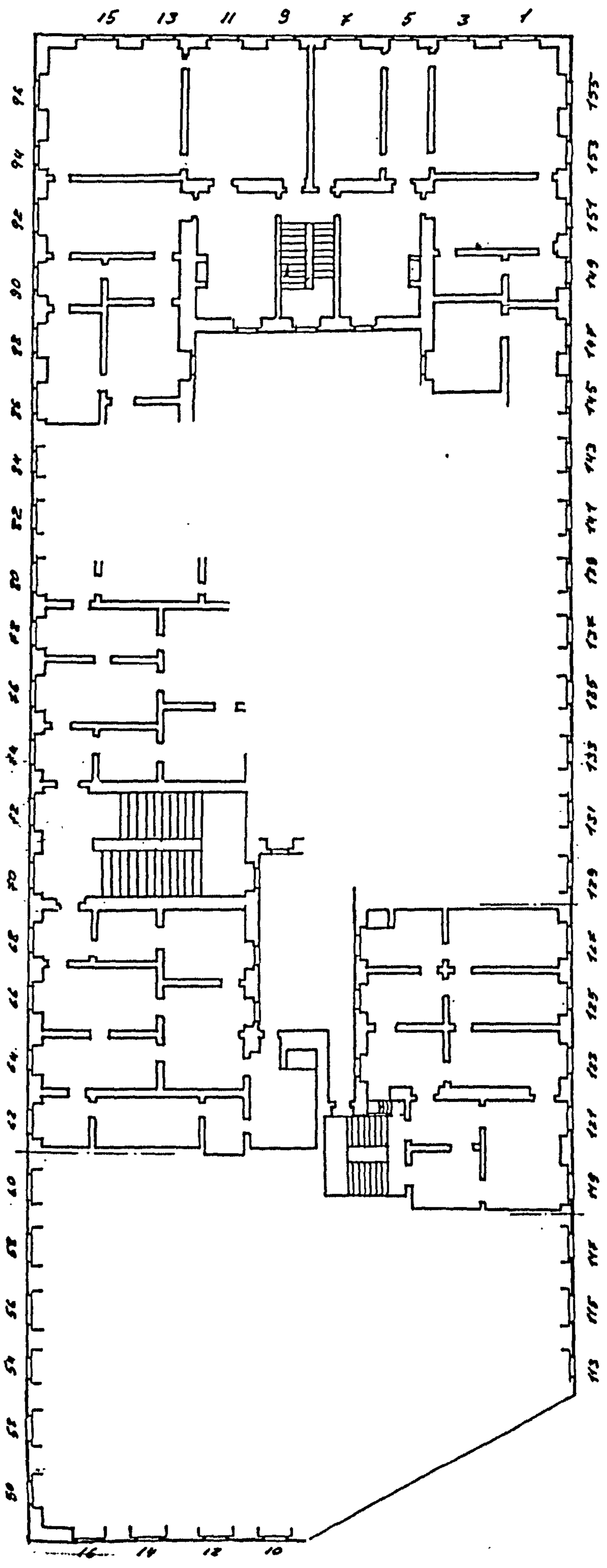
116 118 120 122
32 30 28 26 24 22 20 18
R. DE S. NICOLAU

Plan 28


R. DA VITÓRIA
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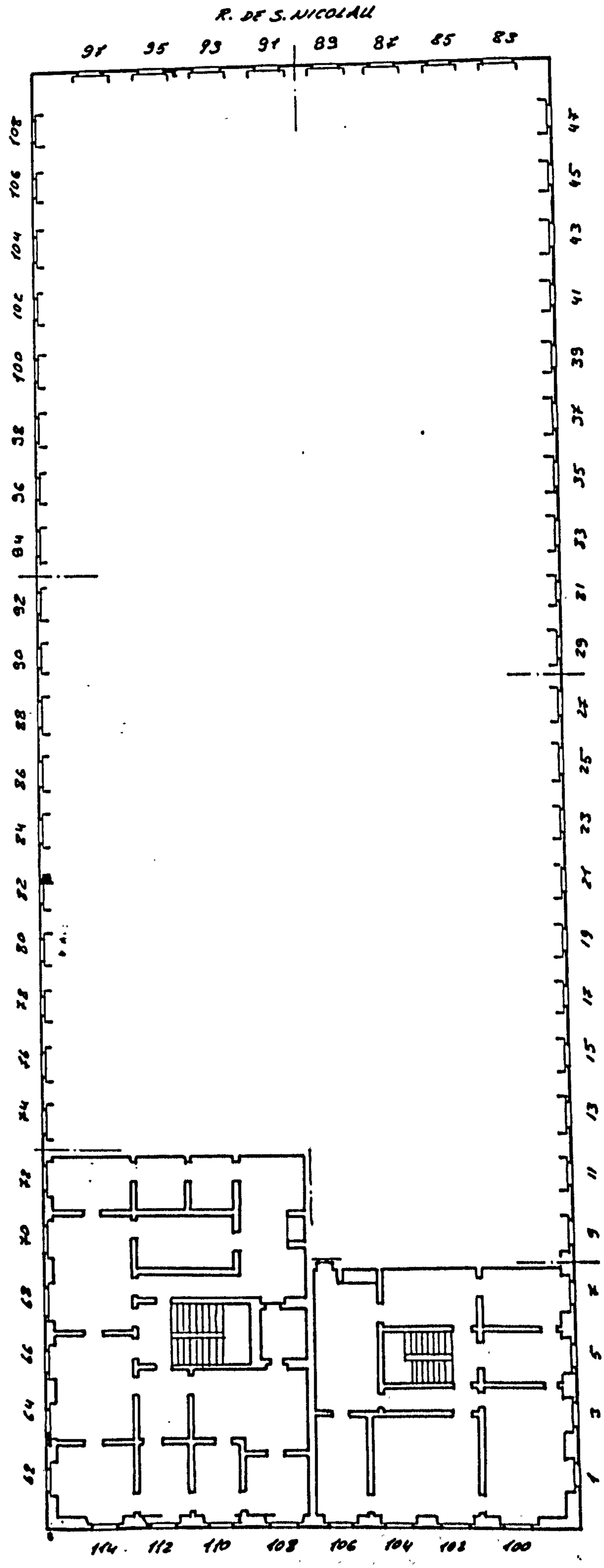
R. DOS DOURADORES
R. DOS PAUQUEIROS
R. DE S. NICOLAU
16 14 12 10

Plan 29


R. DE S. NICOLAU
91 95 93 91 89 87 85 83
43 45 43 41 39 37 35 33 31 29 27 25 23 21 19 17 15 13 11 9 7 5 3 1
R. DOS SAPATEIROS
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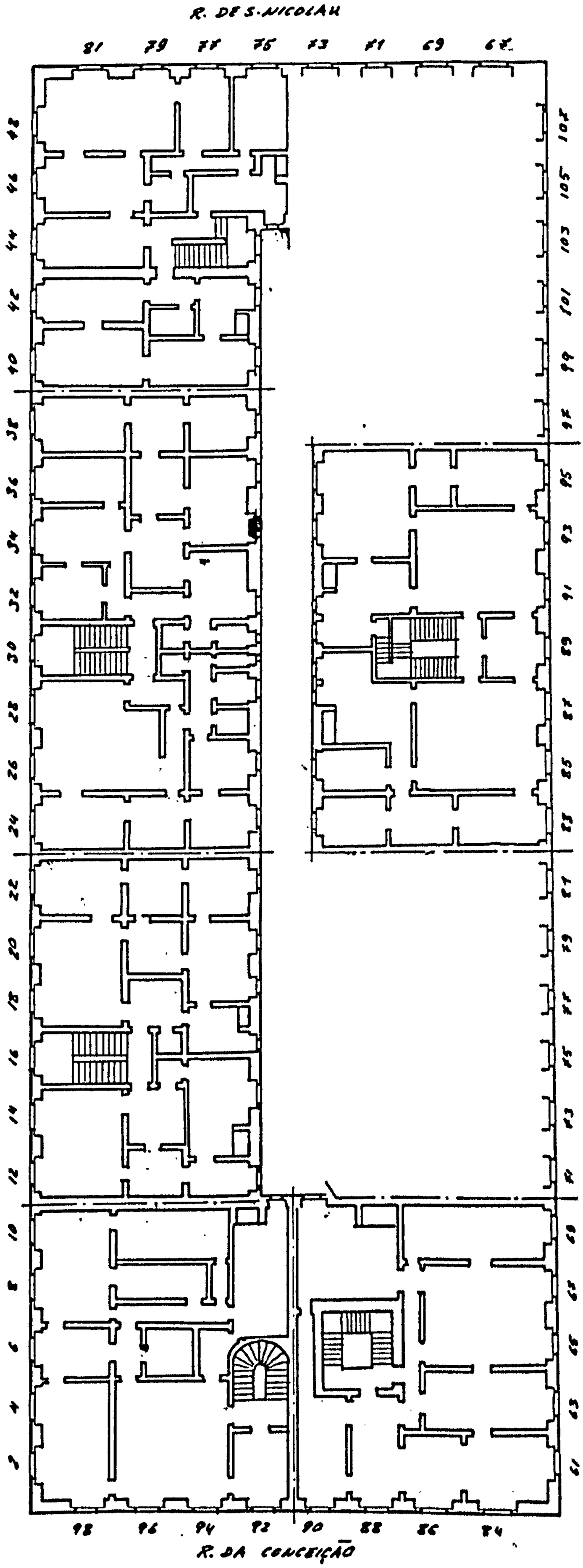
84 86 88 90 92 94 96 98 100 102 104 106 108
R. DO OURO
R. DA CONCEIÇÃO

Plan 30



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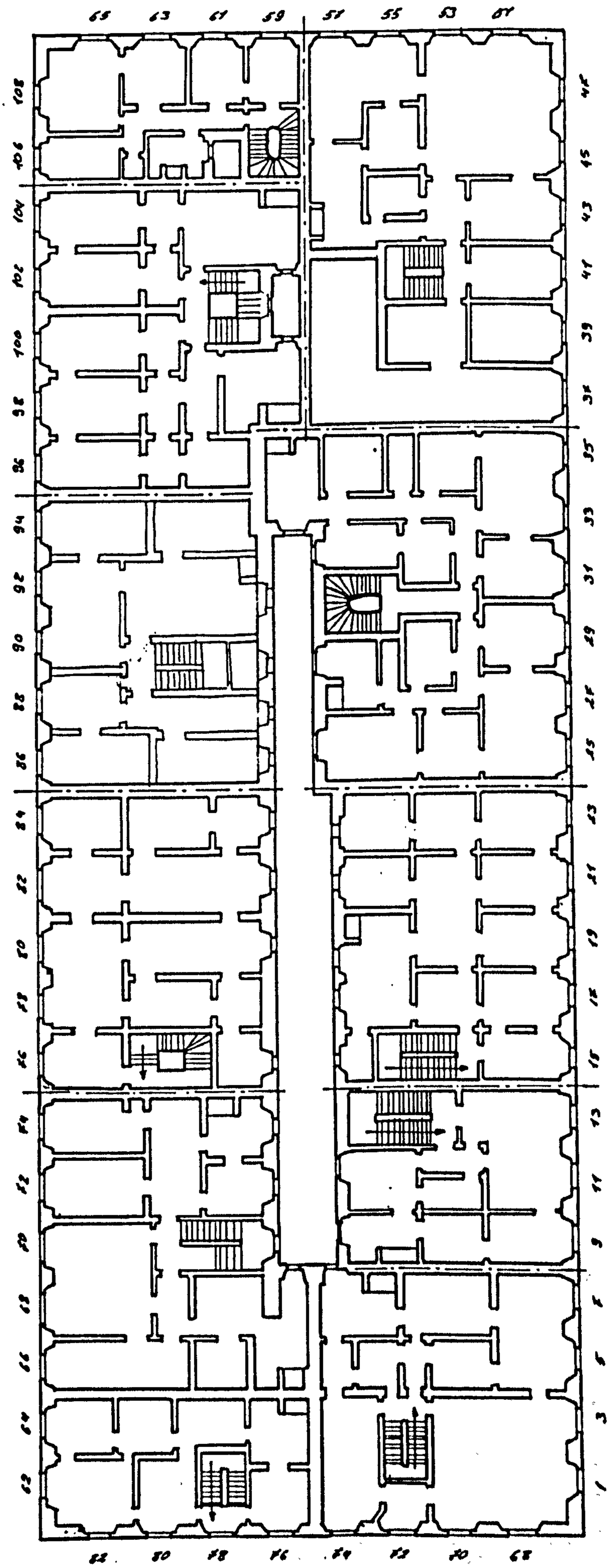

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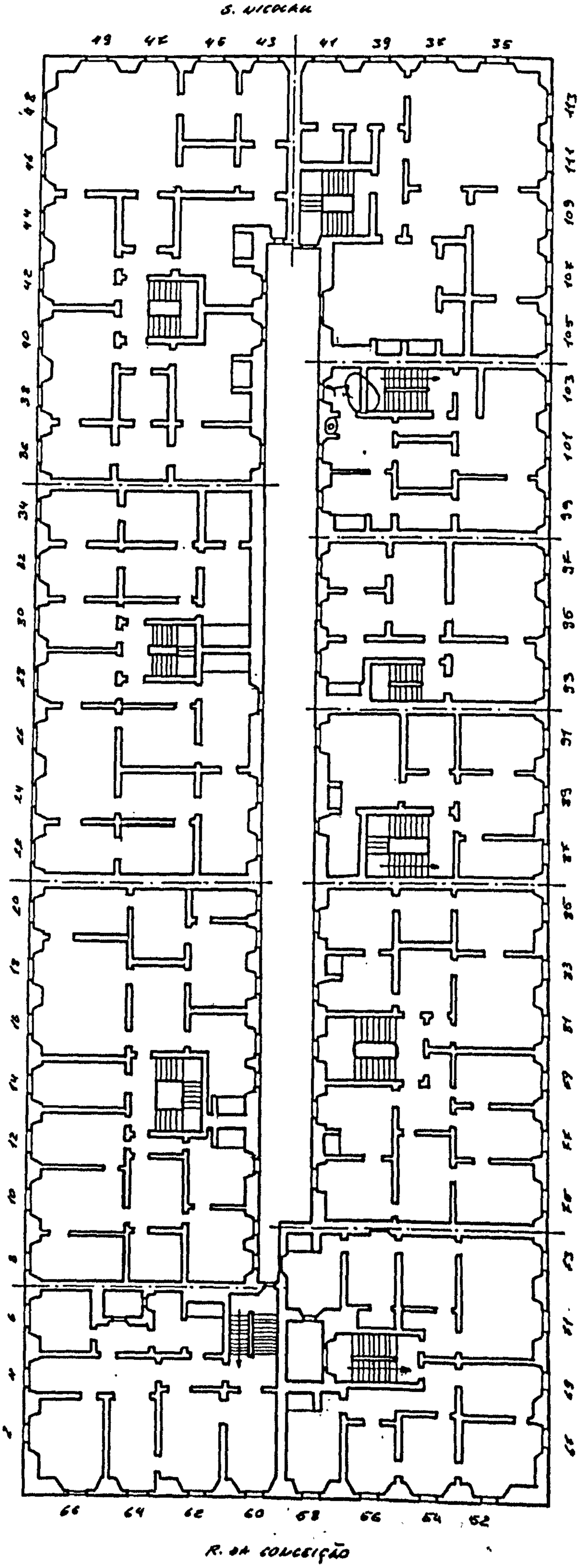
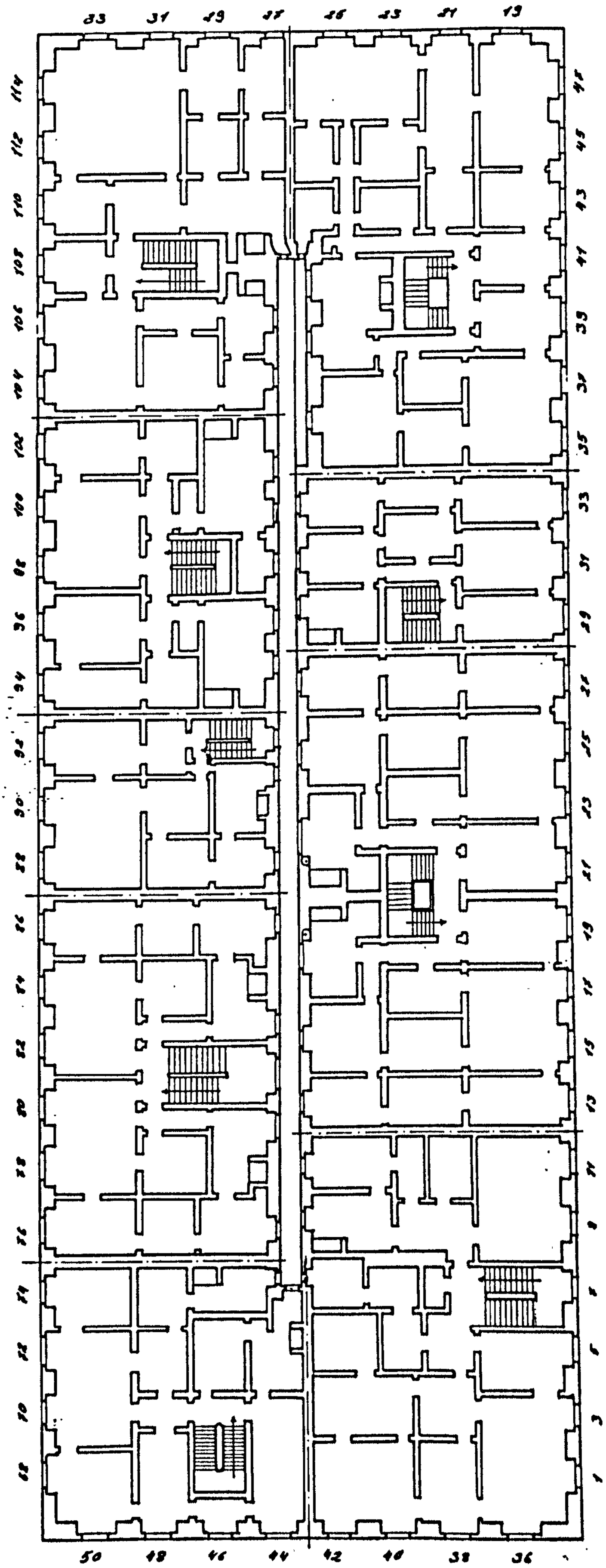
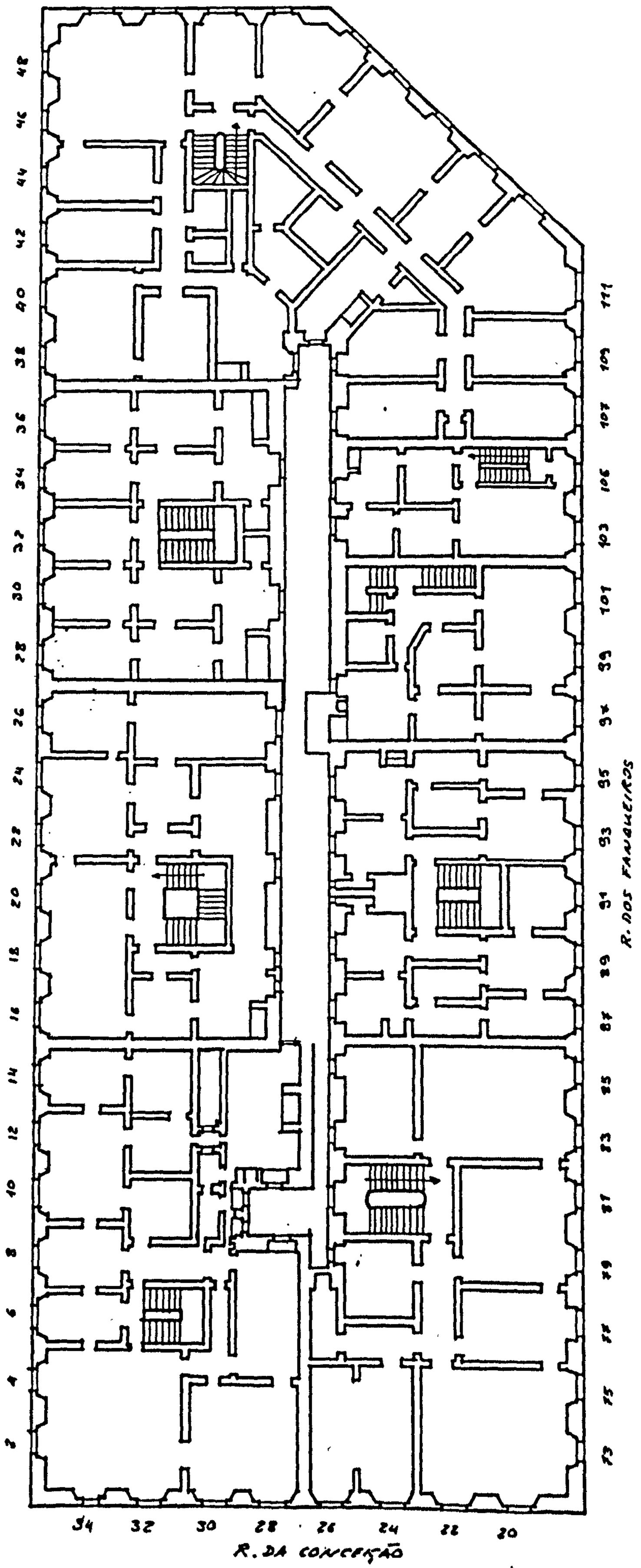


Plan 33



Plan 34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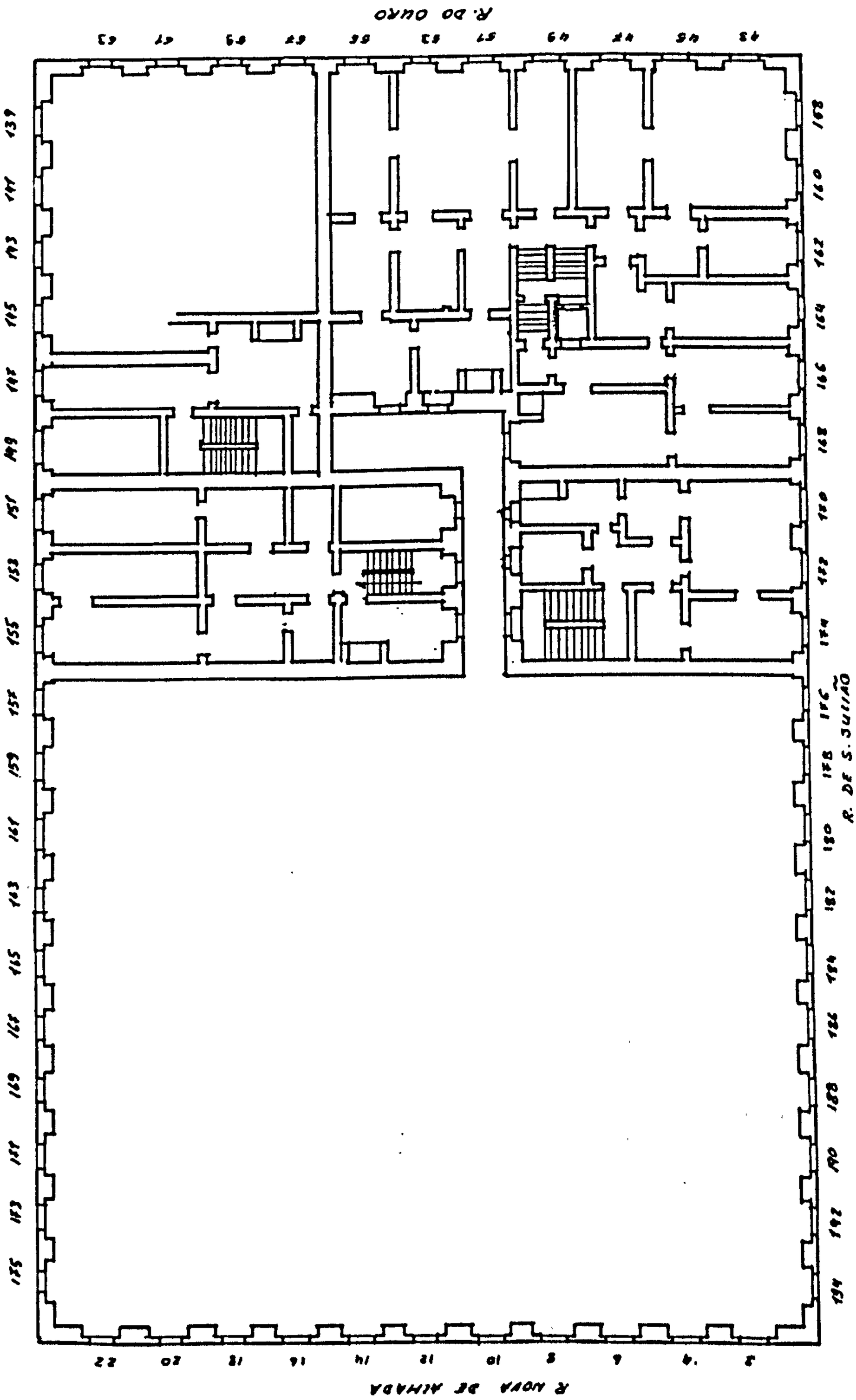
R. DOS FANQUEIROS
R. DA CONCEIÇÃO

Plan 35



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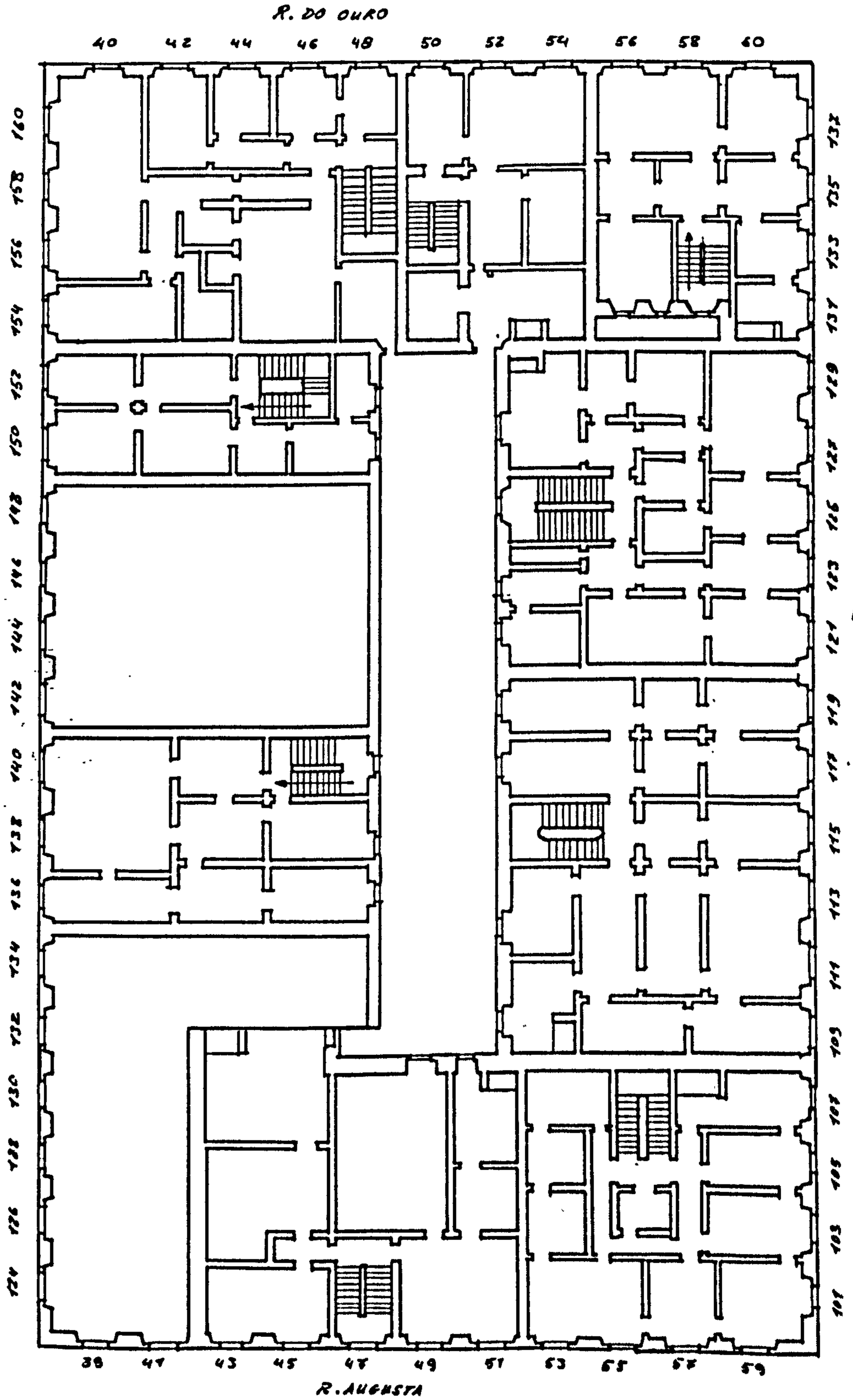
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R. AUGUSTA
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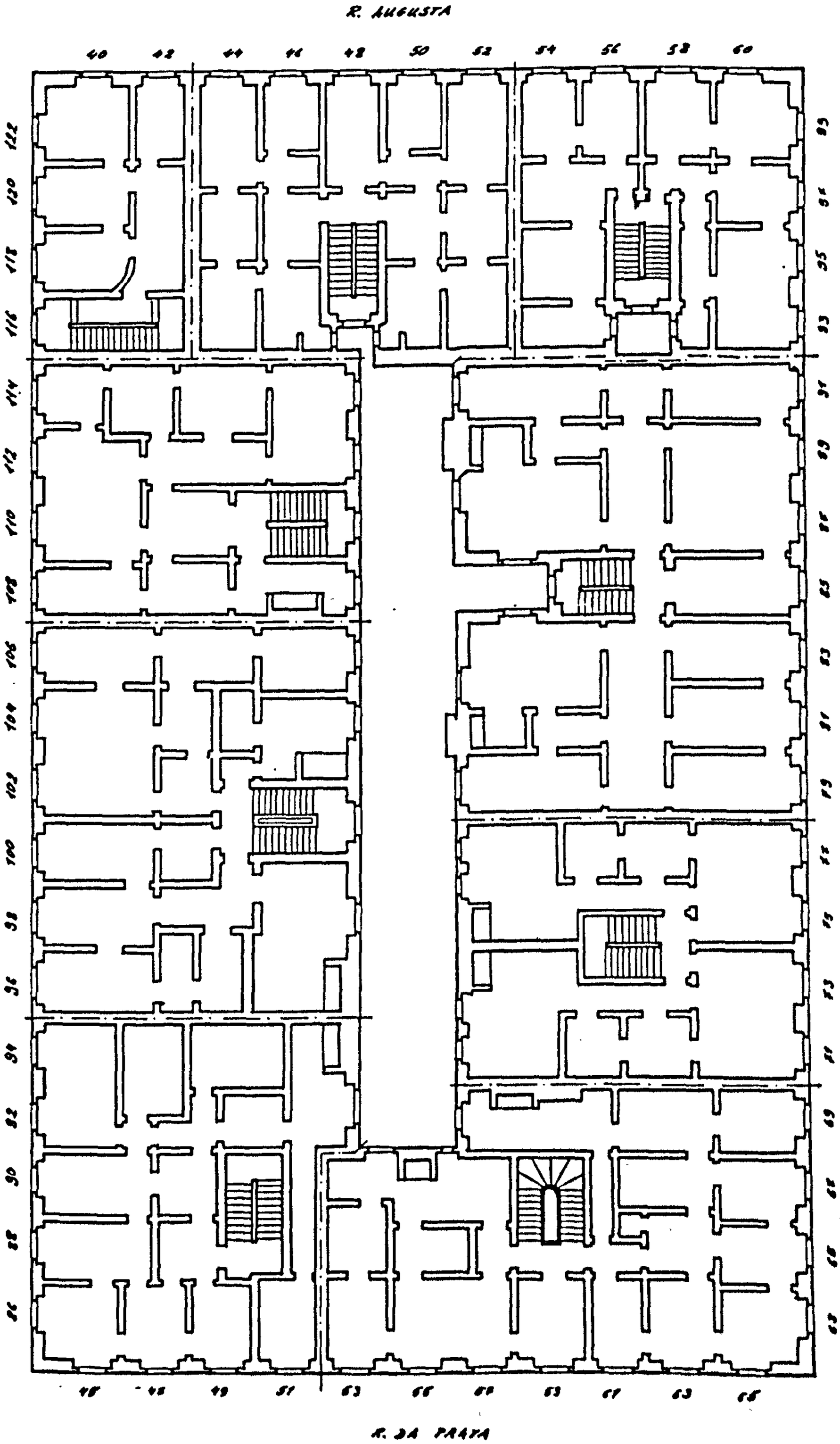
Plan 37



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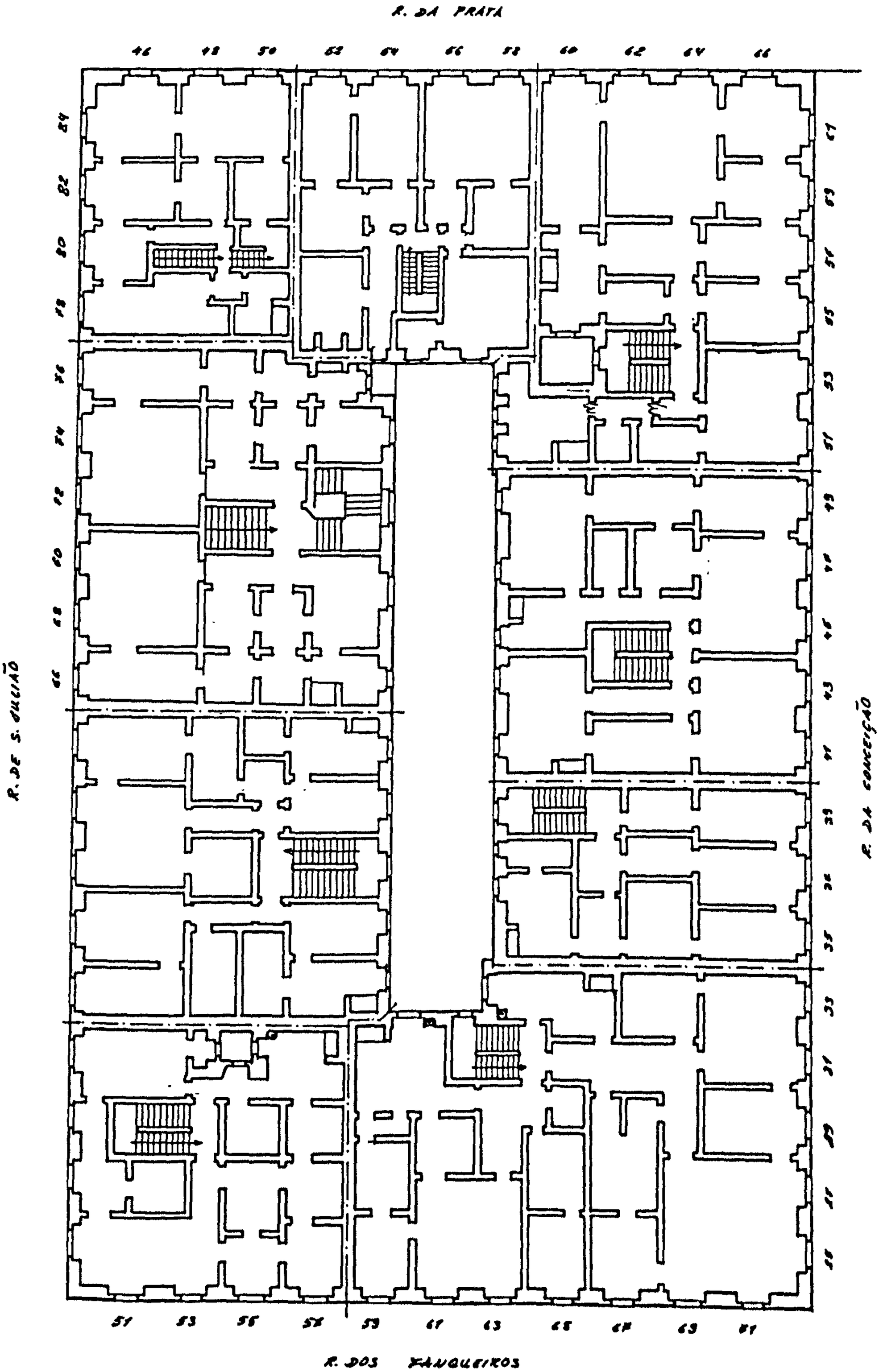
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R. DA CONCEIÇÃO
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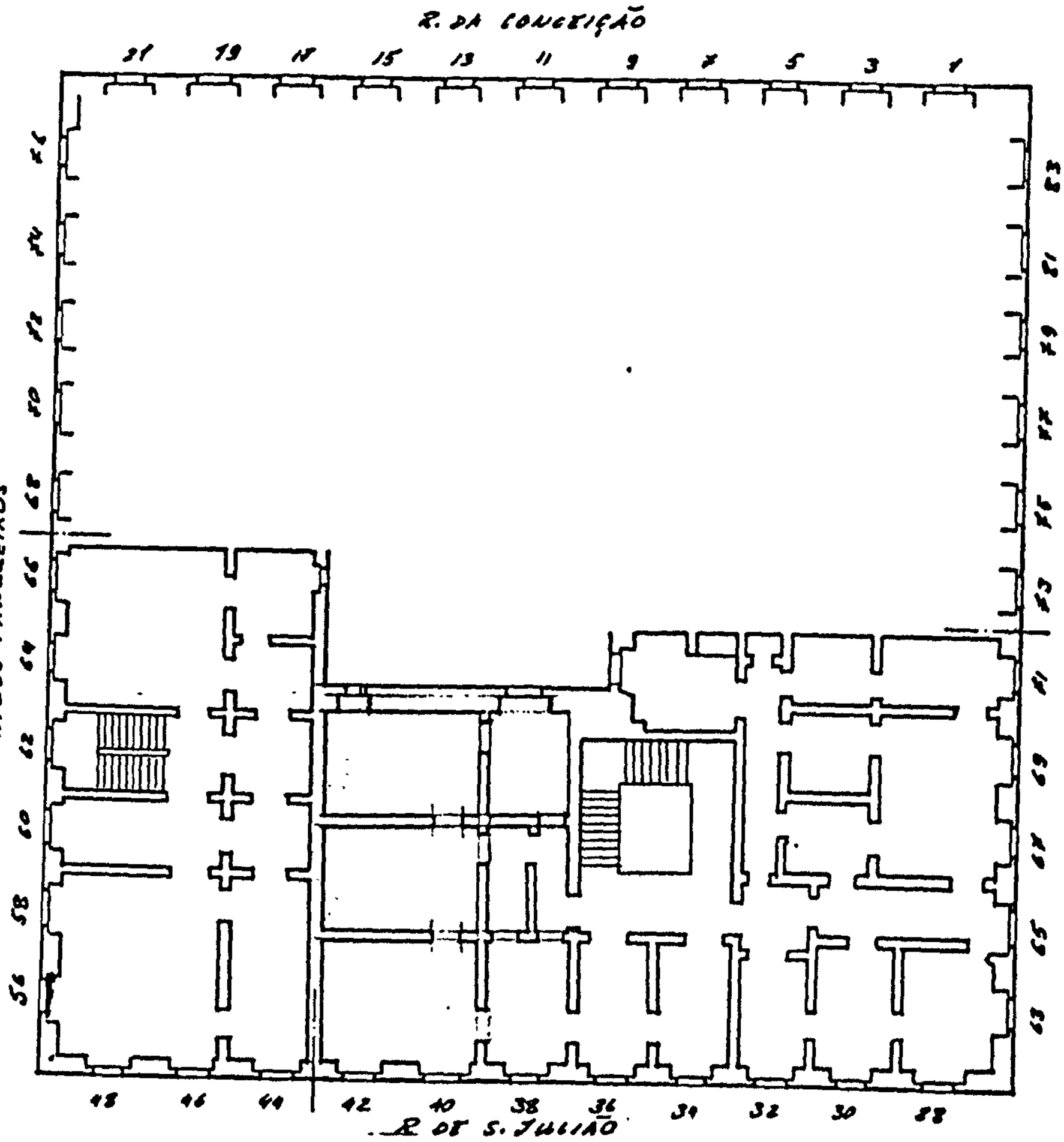
R. DOS FANQUEIROS

Plan 39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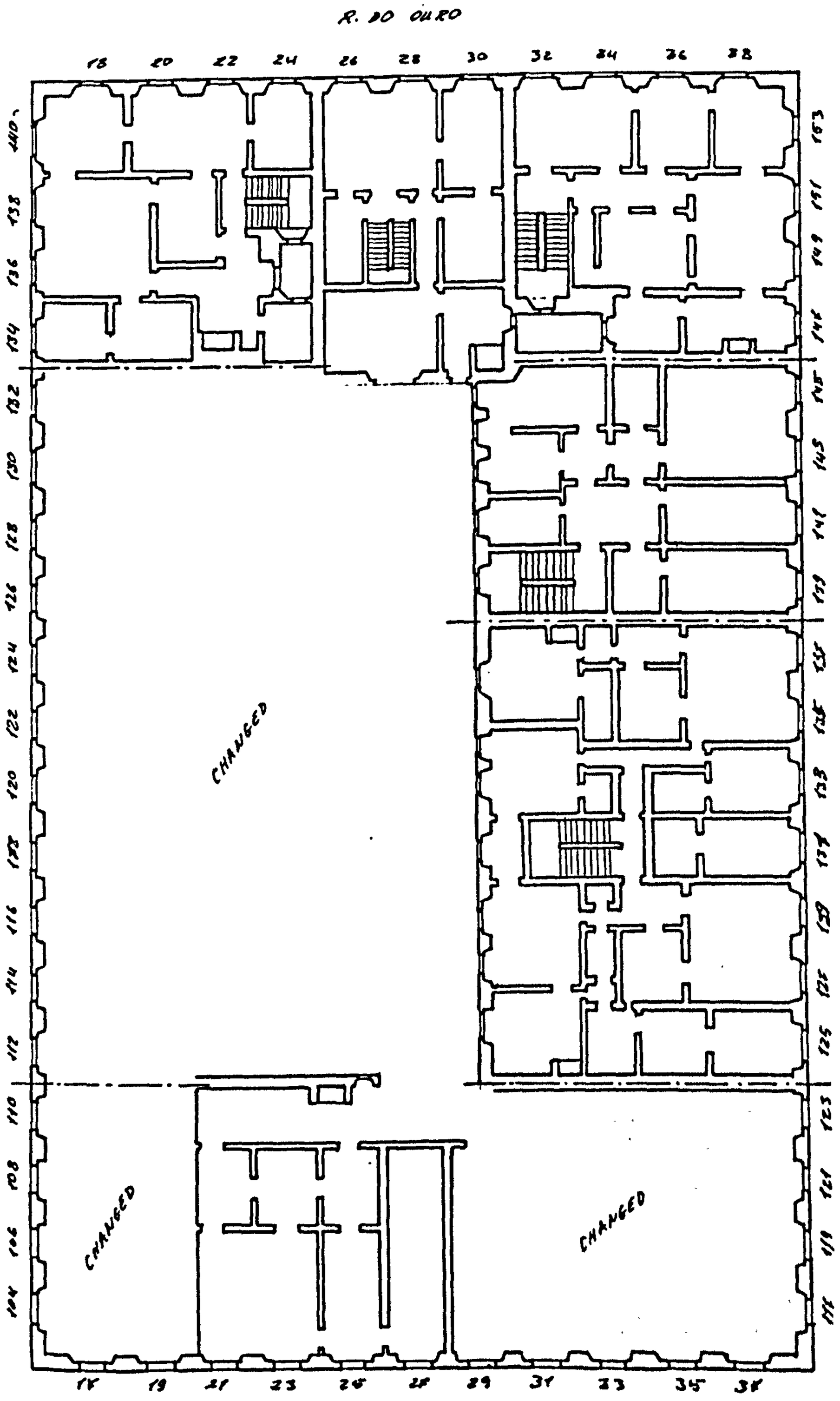
R. DE S. JULIÃO

Plan 40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163 161 159 147 145 143 141 139 137 135 133 131 129 127 125 123 121 119 117
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R. DE S. JULIÃO
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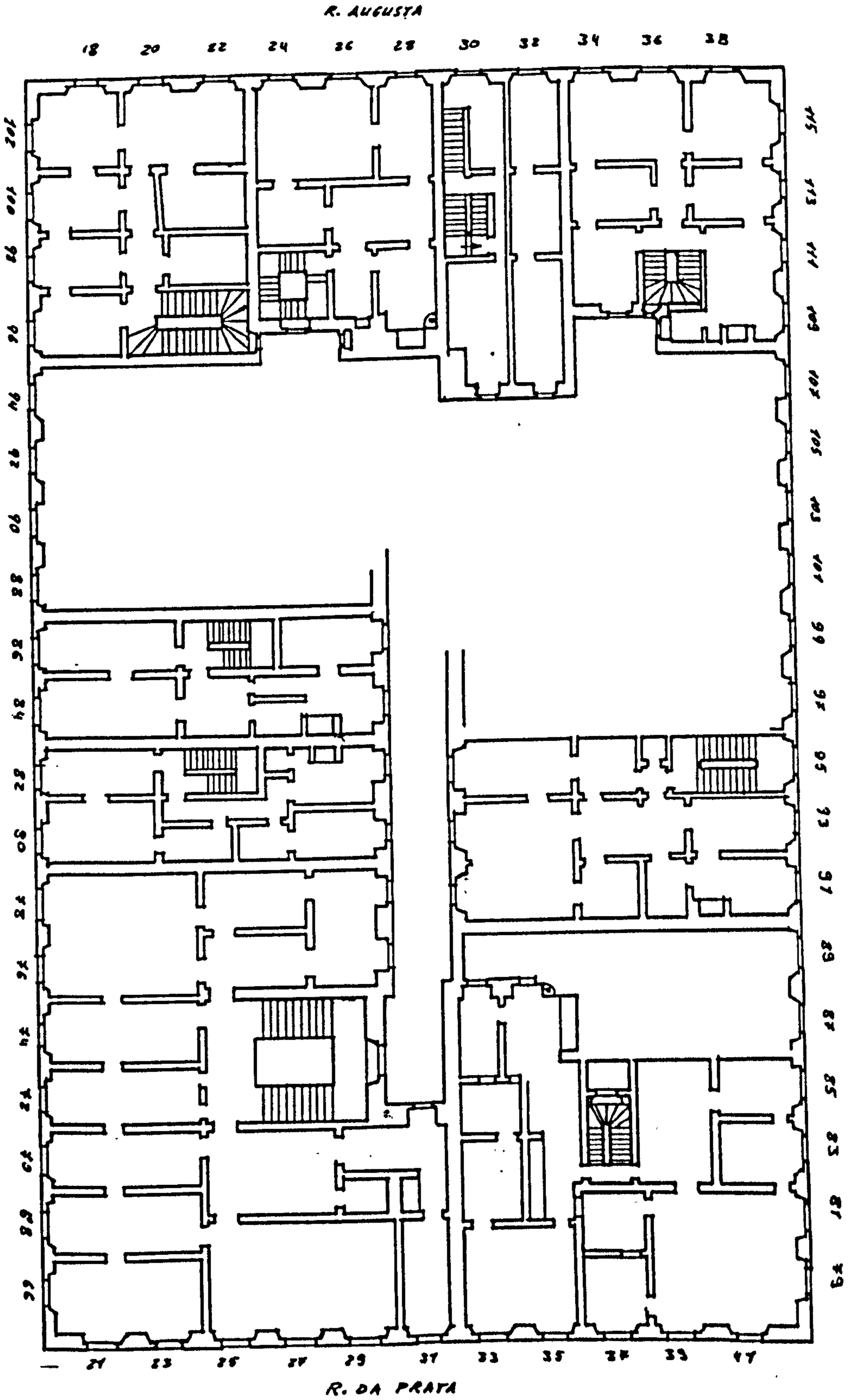
19 21 23 25 27 29 31 33 35 37
R. AUGUSTA

Plan 41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R. DE S. JULIÃO
R. DA PRATA

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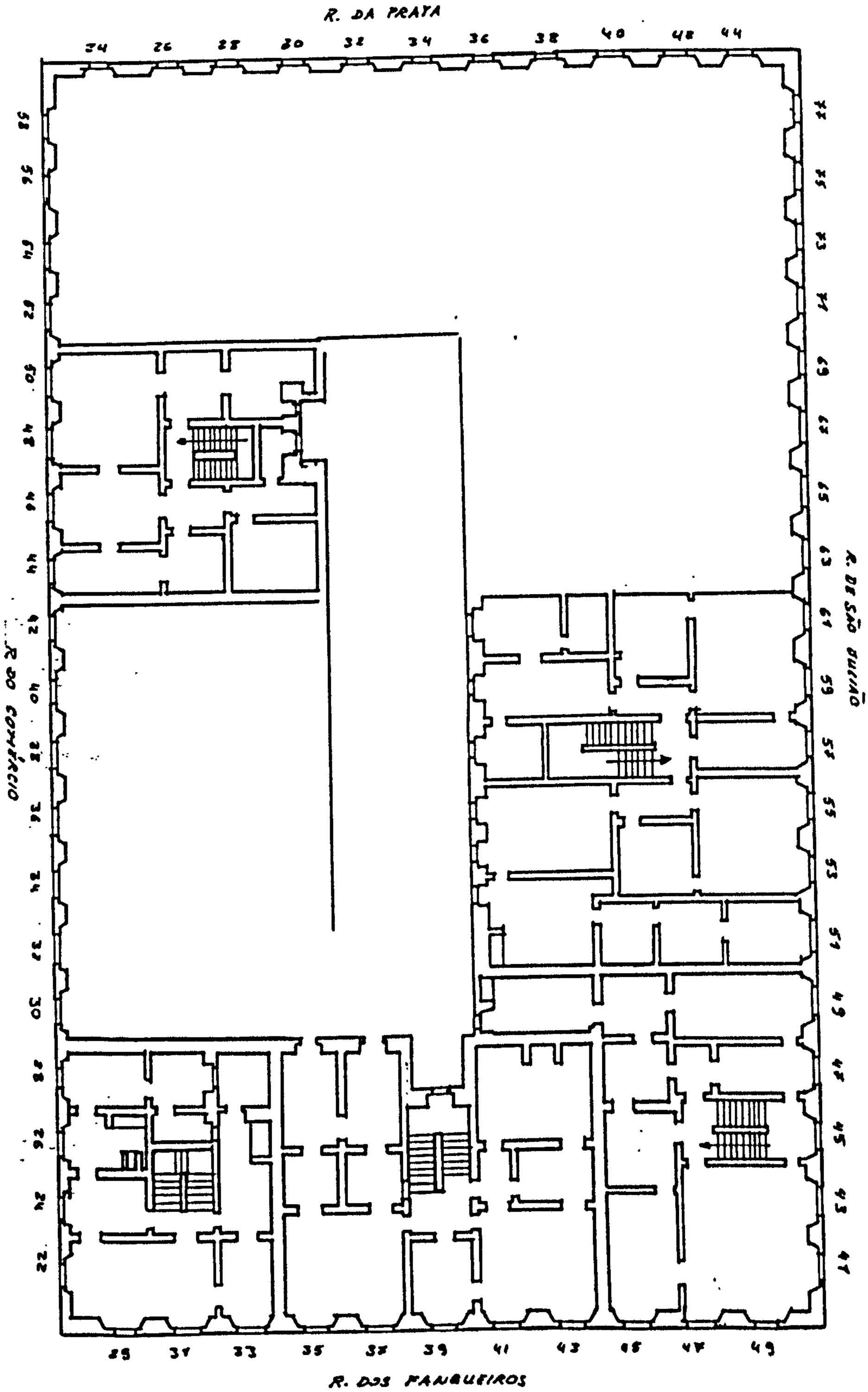

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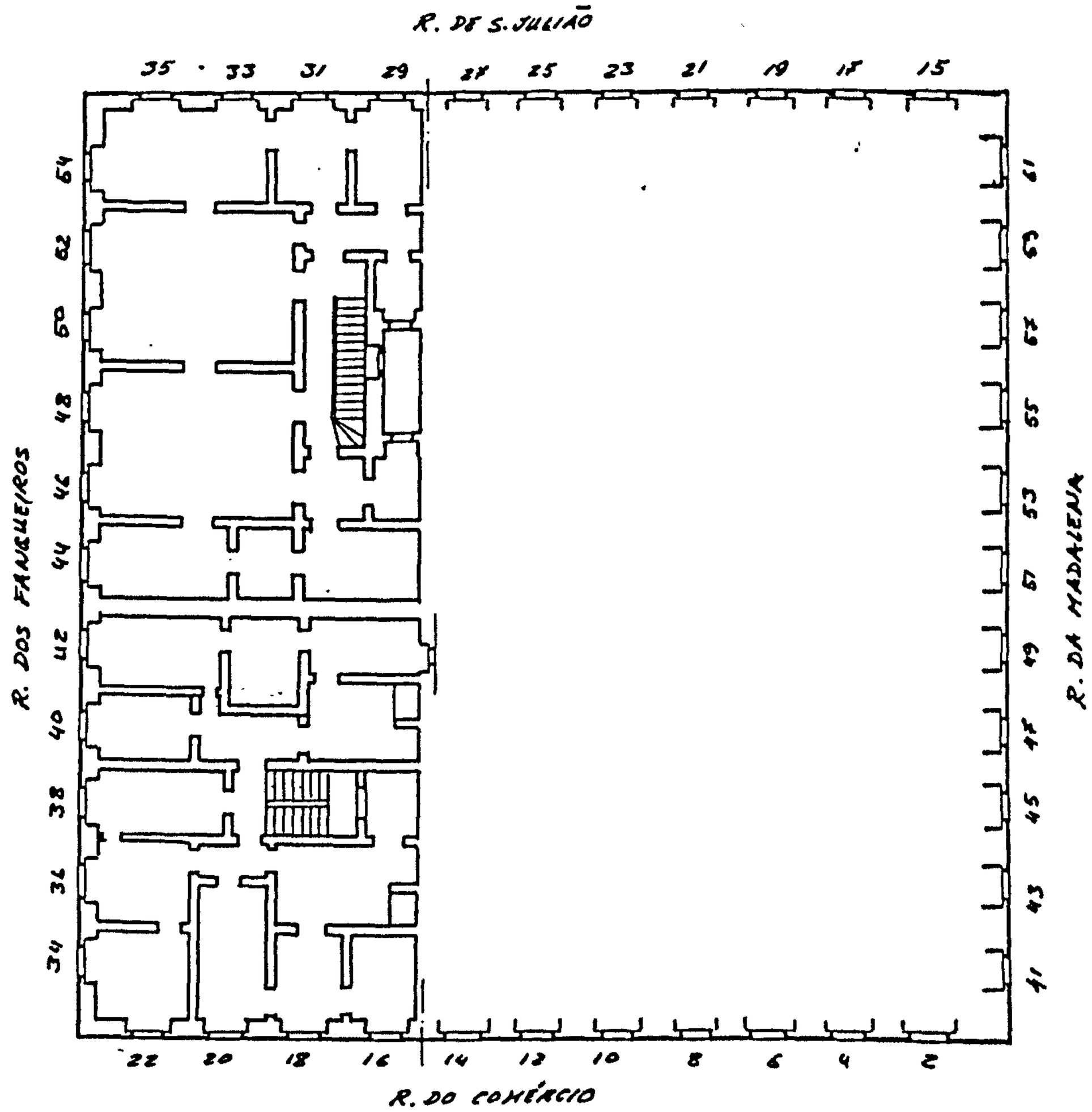
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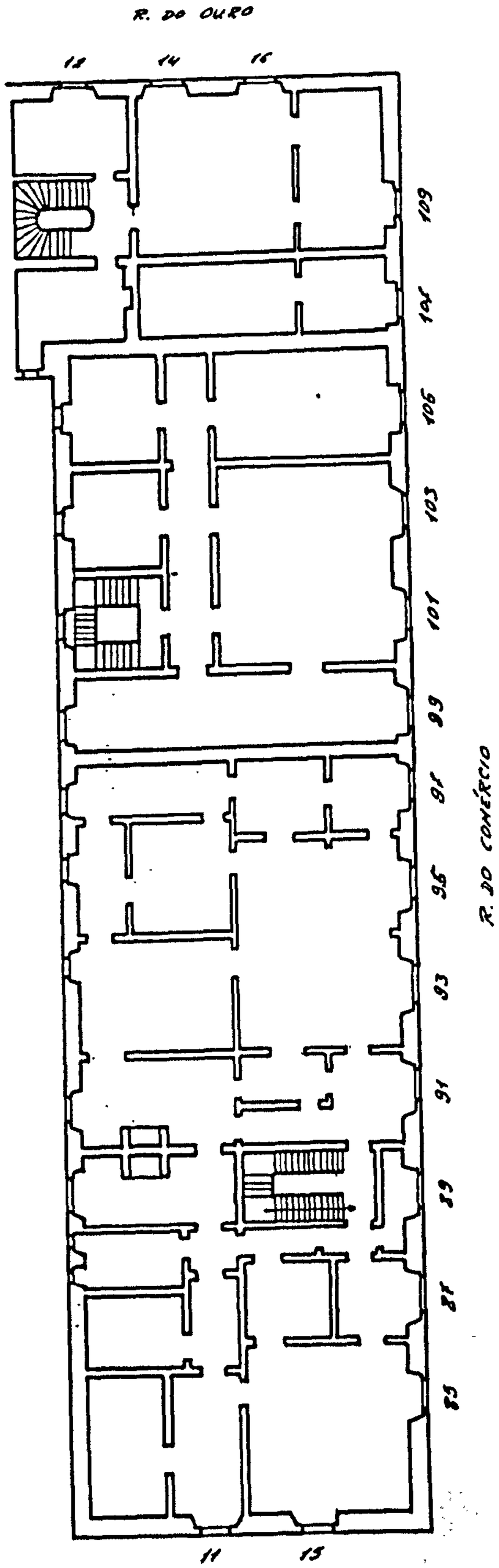
22 20 18 16 14 12 10 8 6 4 2
R. DO COMÉRCIO

Plan 44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R. DO COMÉRCIO
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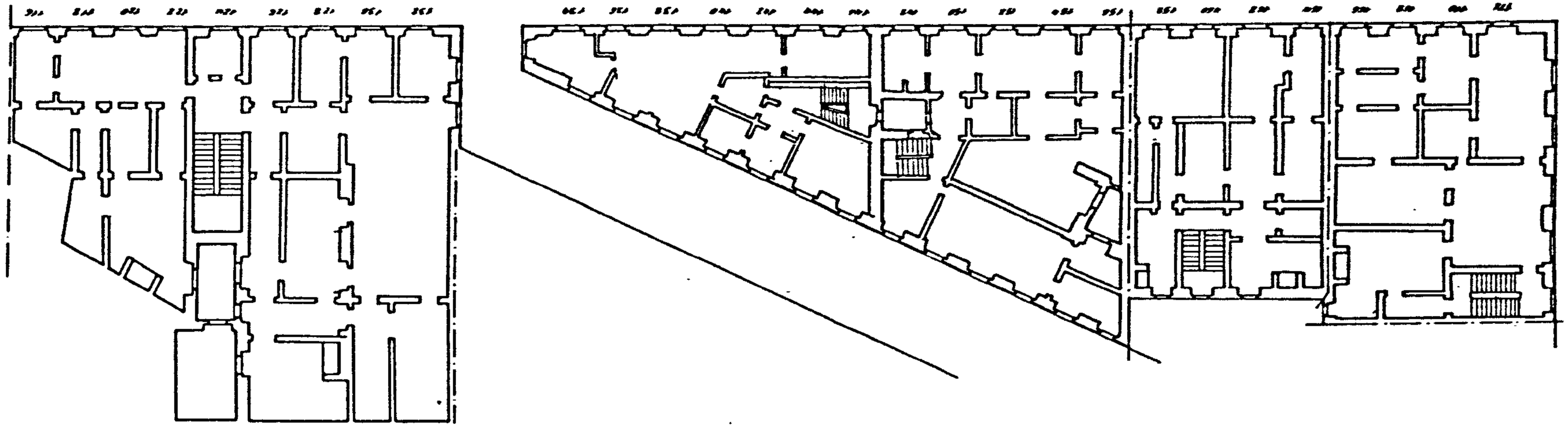
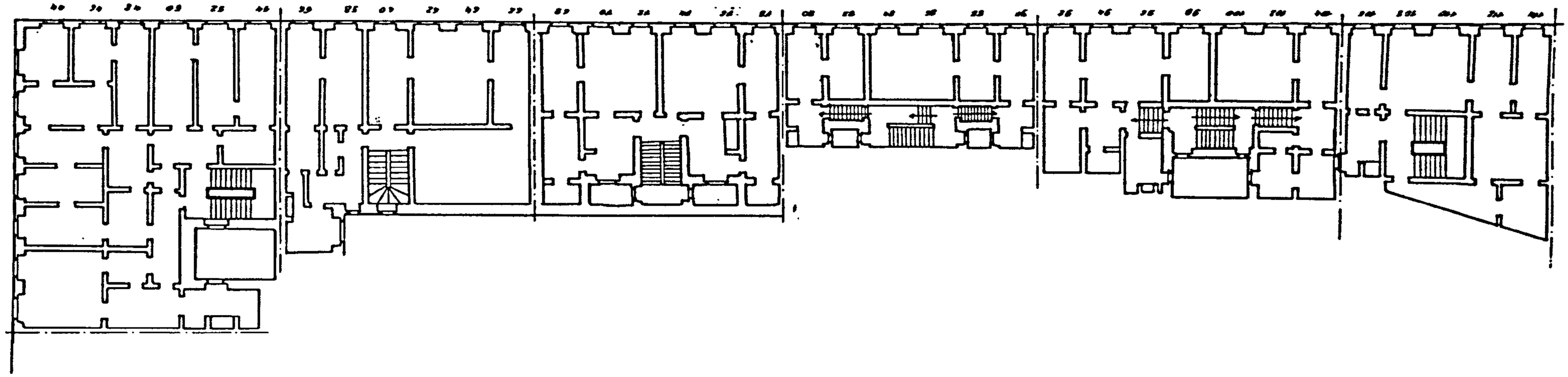
R. AUGUSTA

Plan 45





Appendix 6 - A brief study of the stability of the Pombaline rentable buildings.

In this appendix the static behaviour of a building is explained so as to make it possible to understand the underlying principles behind the particular form and design of the buildings as well as to represent the porticos of the complete cage of a building in detail, 50-54, Ouro Street.

6.1 Foundations

The piles, 12 mm in diameter and not more than 1,5 m long, have only a modest capacity of transmitting the building´s load to the ground through their surfaces.

Their essential function was to allow the commencement of construction on flooded soil, but partly also to prevent the building from sinking into the alluvium.

The capacity of the building to resist small earthquakes was due to the solid construction of the walls, the foundation arches and the vaults which covered the groundfloor, which prevented the lower part of the building from being crushed.

On a wall with a linear foundation, the balance of the loads can easily be understood, (Fig.6.1):

Ia - Arch thrust

P - Foundation wall and upper floors´ self weight.

F - Ground impulsion.

R - Resultant of the forces of impulsion and weight, direction moves towards the vertical by the action of force F. After the construction of the building, as the force P is very high, the influence of force F is of little significance.

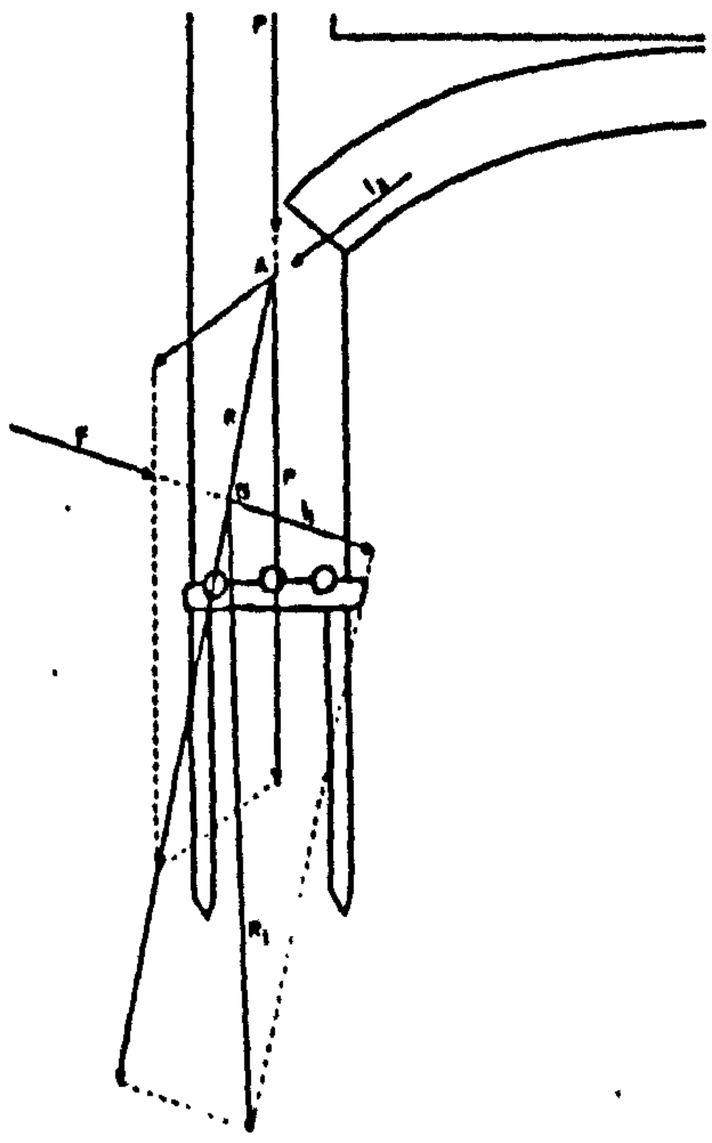


Fig.6.1-Stability of foundations

6.2 Walls at ground floor level

The estimate of the exterior lateral wall thickness on the ground-floor is shown in the following scheme, (Fig.6.2):

P - Is the minimum wall thickness.

S - Vault thrust.

P_1 - Upper wall self weight.

T - Wall self weight.

By summing P and T we get force Q, whose line of action concurs with that of force S on point A, resulting in force R.

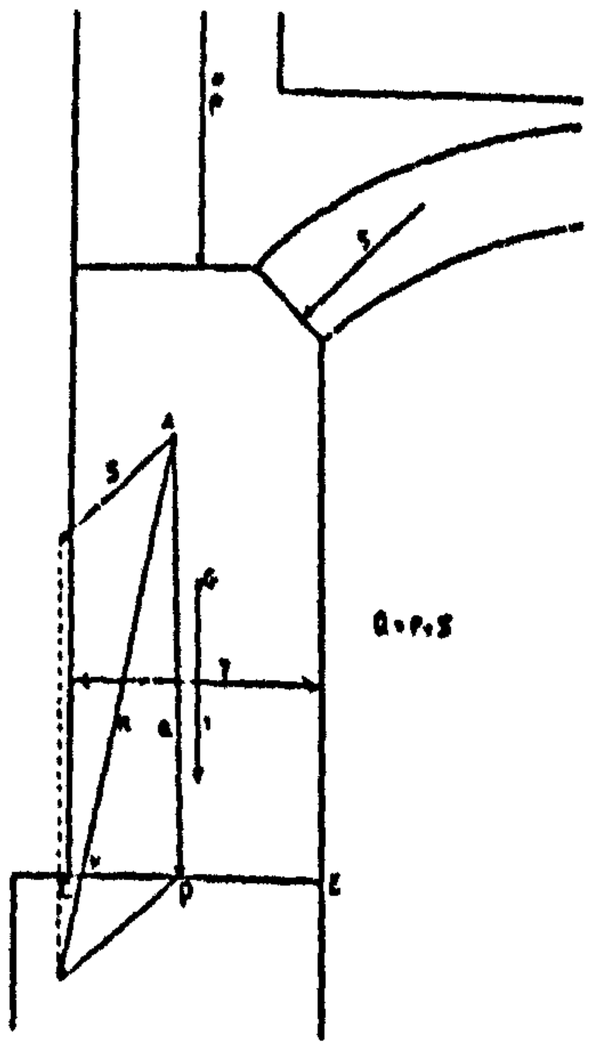


Fig.6.2-Stability of ground floor

The force R must fall into the base CE of the wall.

The wall thicknesses were lessened because the self weight of the wall in the Pombaline buildings was high, due to their number of floors. The pressure of R in the CD interval is nil in D, and double the average in C.

6.3 Arches

An important factor in estimating the stability of the groin arches, which joined the vaults together is the magnitude of the rise.

The higher the rise, the greater its stability, because the thrust is more and more vertical, not demanding too thick a wall.

On the rentable building the choice was for depressed arches.

To determine the value of the thrust it is sufficient to consider half of the arch, whose forces are the following, (Fig.6.3):

R - Reaction or impulsion exercised on D at 2/3 of the height in the keystone section.

P1 - Semi-arch´s own weight.

P - Total overload of the material used in completing the extrados.

F - Wall´s reaction applied at A to the imposed load at one third of the depth of the arch.

The vault will only be in equilibrium, if forces S, R, R, P and P1 nullify themselves.

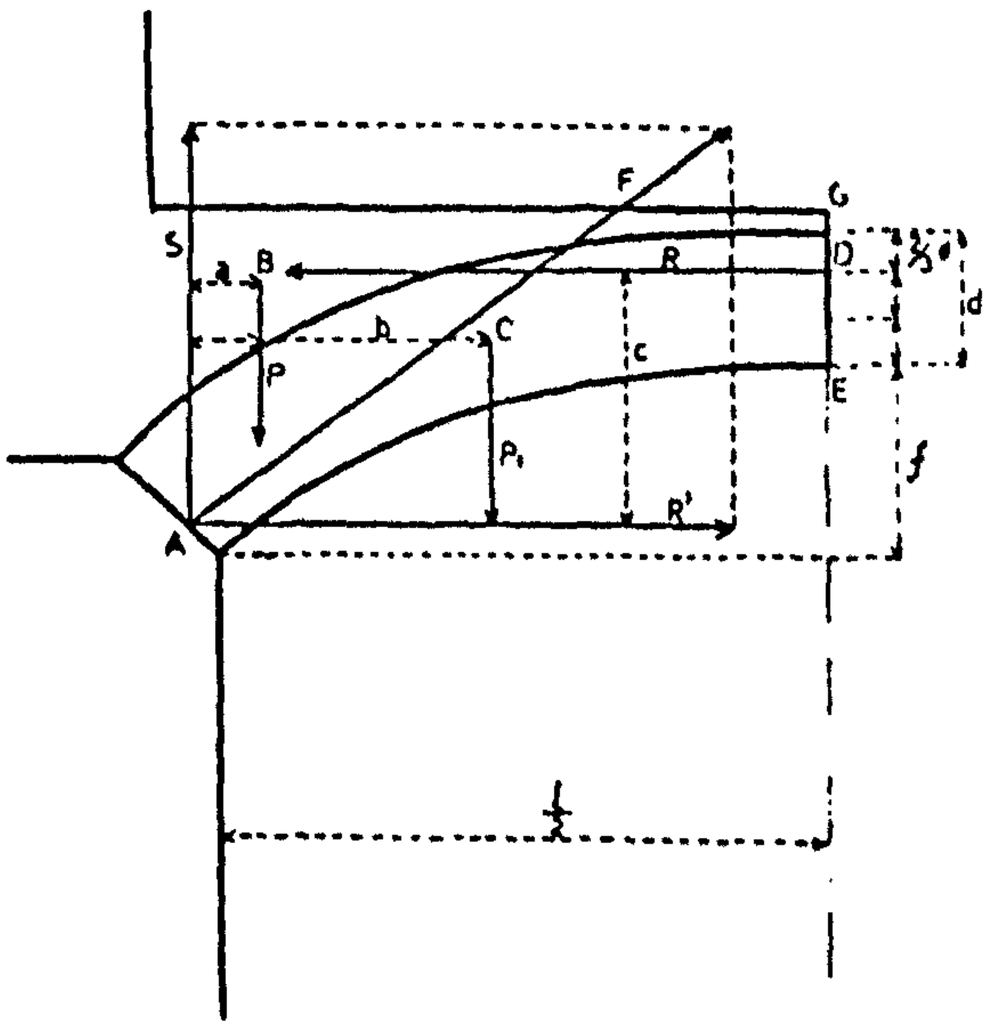


Fig.6.3-Stability of the arches

It is easy to see that, in the keystone of the arch the materials are subject to unequal charges. At point E they are null, increasing progressively until they are double at G.

The arch´s function is to normalize the thrust created by the vaults during and after construction.

6.4 Vaults.

Vaults with flattened edges are the result of the intersection of two depressed vaults, equally high, at right angles on plan, having dissimilar spans, as happens with rectangular rooms. Because they have equal heights in horizontal projection the intersection edges are represented as two diagonal straight lines.

To study the balance of forces, we will consider a rectangular vault in which X and Y are its axes.

Considering only section A of the depressed vault we have, (Fig.6.4):

Ia - Impulse of one area of the vault.

Pa - Vault´s own weight plus weight of the materials used in completing the extrados.

La - Distance between the axis and the centre of the vault´s starting junction.

To calculate the section´s moment we have:

$$Iaf1 = PaLa \qquad Ia = \frac{PaLa}{f1}$$

Therefore for section b we have:

$$Ib = \frac{PbLb}{f1}$$

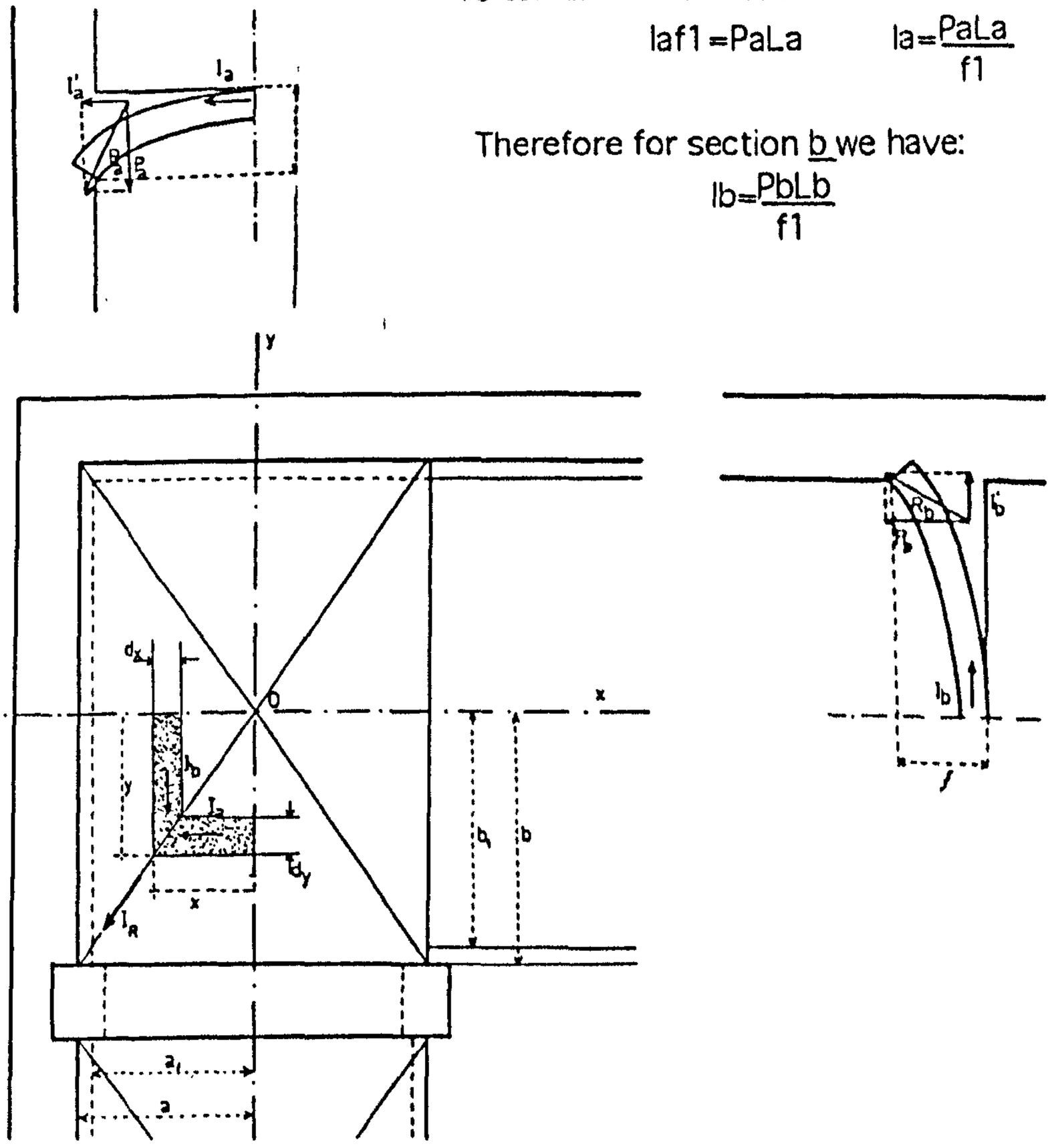


Fig.6.4-Stability of the vault

The thrusts are not discharged directly to the walls but through the ogees´ planes, where both the barrel´s thrust produce a force which goes from the ogees´ edges to the supporting piers.

The greater the flattening of the layout, the greater the vault´s barrel thrust, therefore the thrust of the barrel b has the same rise as a, but because it covers a larger span, it produces a greater thrust. This imbalance of thrust is lessened by the neck piece arches placed between the vaults.

There is also a logical reason why the brick voussoirs are arranged almost in circles around the centre of the vault.

If the bricks were placed in rows, perpendicular or parallel to the axis, and as

their dimensions are not exactly equal, some rows would be overloaded whilst others would have no load at all, which would result in the crushing of the latter and the failing of the former. Placed in curves, with staggered joints they tie the vault together and allow the thrust to be distributed evenly, (Fig.6.5).

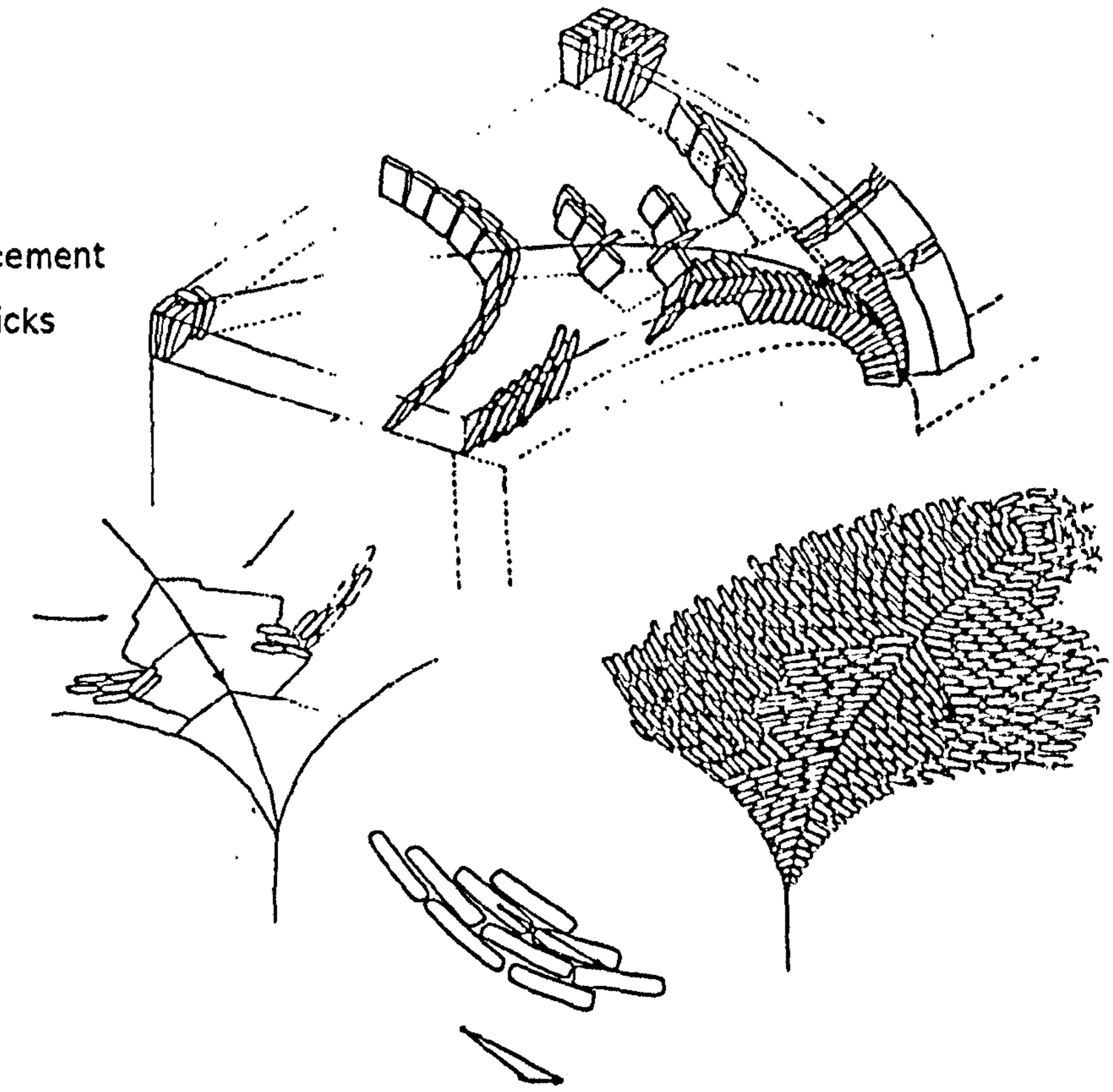


Fig.6.5-Placement of bricks

On the ogees the bricks are disposed perpendicularly to the concentric courses, so that they can receive the loads better, and effectively change a round form into a square or rectangular one.

In the round part, as we advance to the sides, the bricks are still positioned so that they can transfer the weight more effectively onto the arches or onto the walls .

6.5 The façade.

The windows are aligned both vertically and horizontally in order to maintain the balance of forces.

On the stonework between each window-sill and the lintel immediately below, there are always two brickwork features. The first one is almost straight and is called a "pressed up beam", and the second is curved and called a relieving arch. The latter is supposed to lighten the loads above the window lintel, which, because it is made of stone, would not be resistant to great flexural pressures, (Fig.6.6).

Because of the façade´s symmetry, the different arches´ thrusts balance themselves producing vertical forces, which, with the self weight of the masonry between the openings, increase vertically.

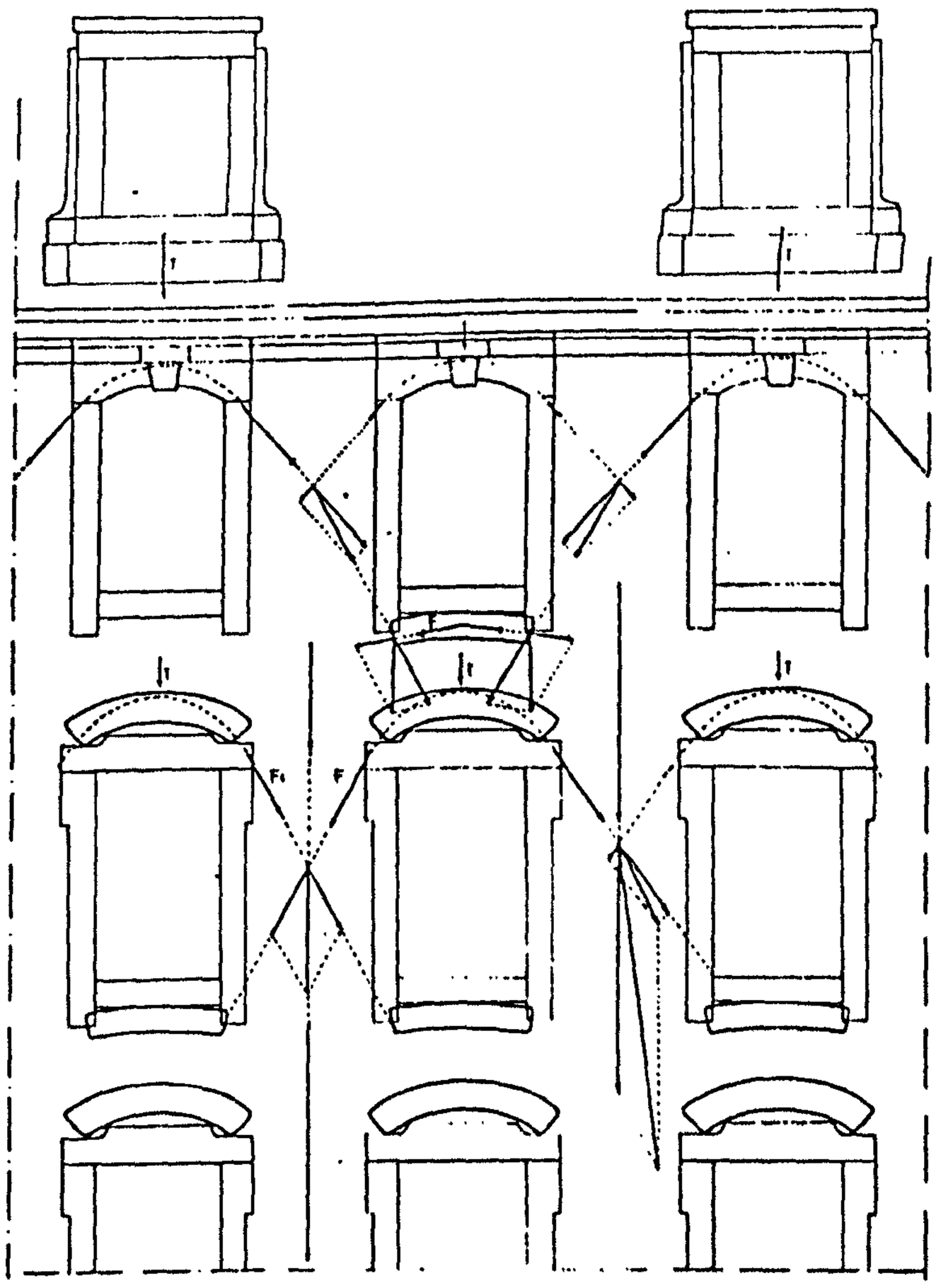


Fig.6.6-Scheme of forces in the façade

6.6 The cage, (Fig.6.7 to 6.23)

The framework's conception followed certain principles which led to increased stability. These principles include, (Fig.6.7):

-The triangular structure of the panels would prevent their distortion.

-Whenever possible the doorways were in the centres of the panels, so that loads could be distributed evenly and at the same time the panels were more solidly buttressed at their corners, (Fig.6.8).

-The joints were designed to work in compression, so that nails were not needed.

-The panels' disposition as sketched (Fig.6.8 and 6.9) was always orthogonally allowing it to react better to the moments caused by horizontal forces.

The noggings placed between the floor joists as well as over partition walls, besides allowing frames to be placed above them, kept the joists in place.

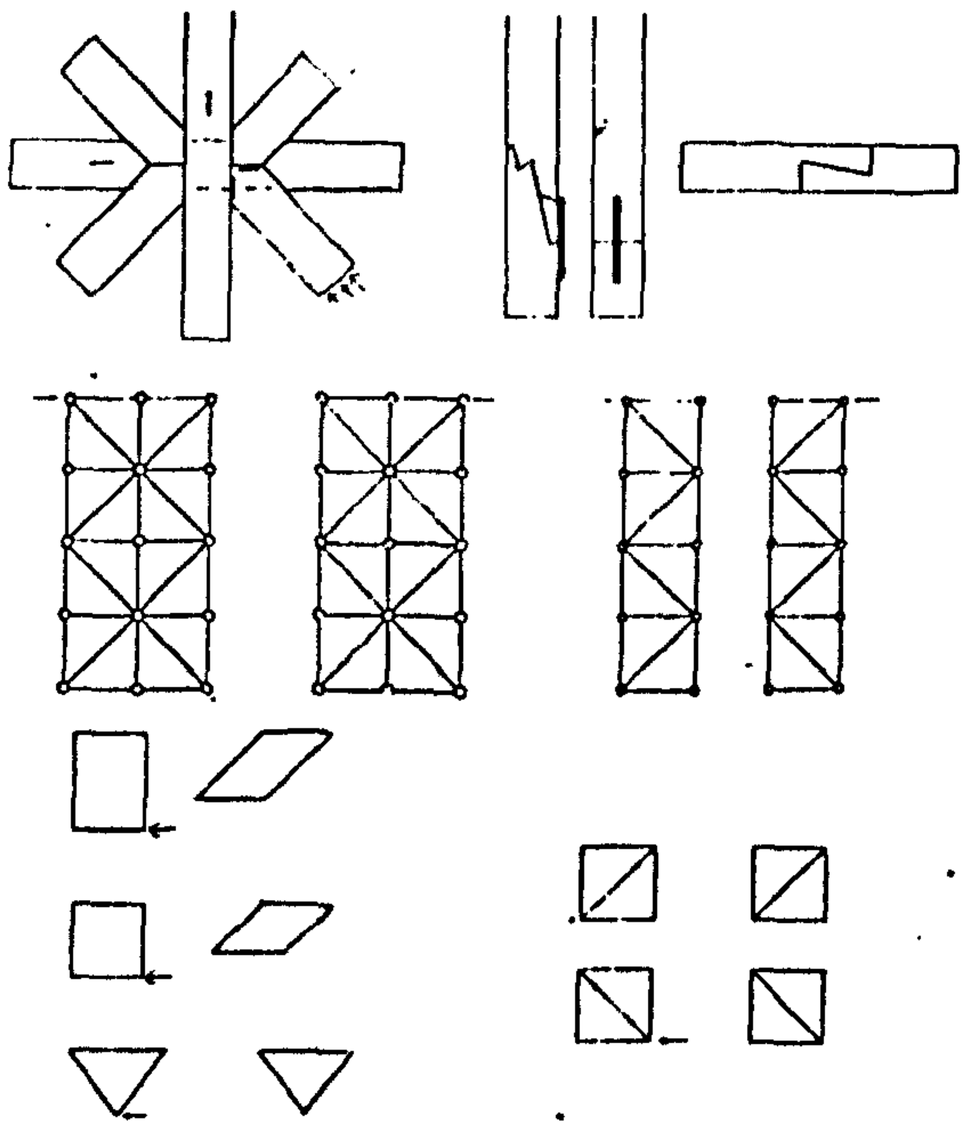


Fig.6.7-The principles of stability adopted on framework conception

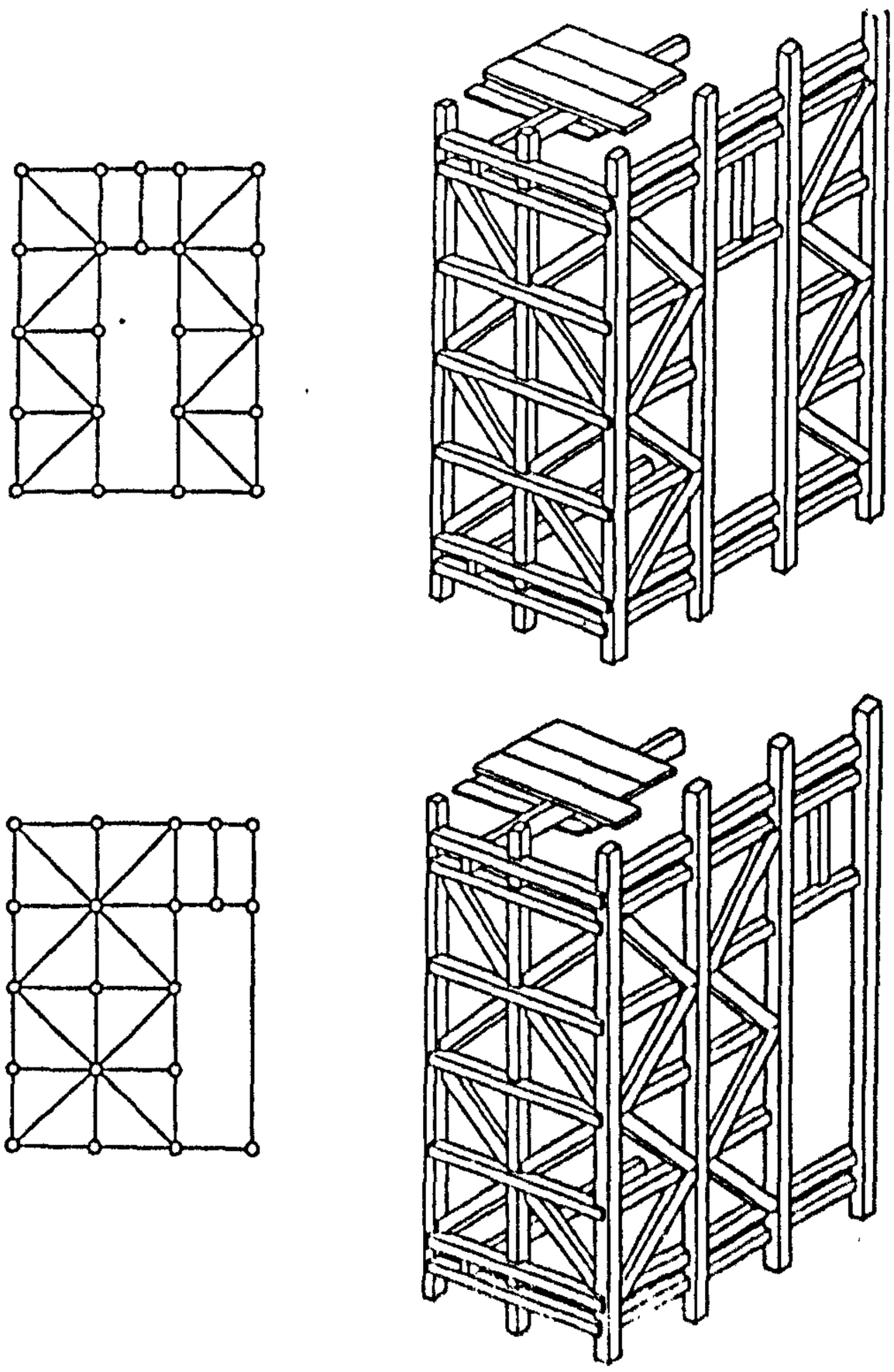


Fig.6.8-The elastic connections of the *gaiola*.

The following dimensioned drawings show the *gaiola* of number 54, *Ouro* Street as a typical example.

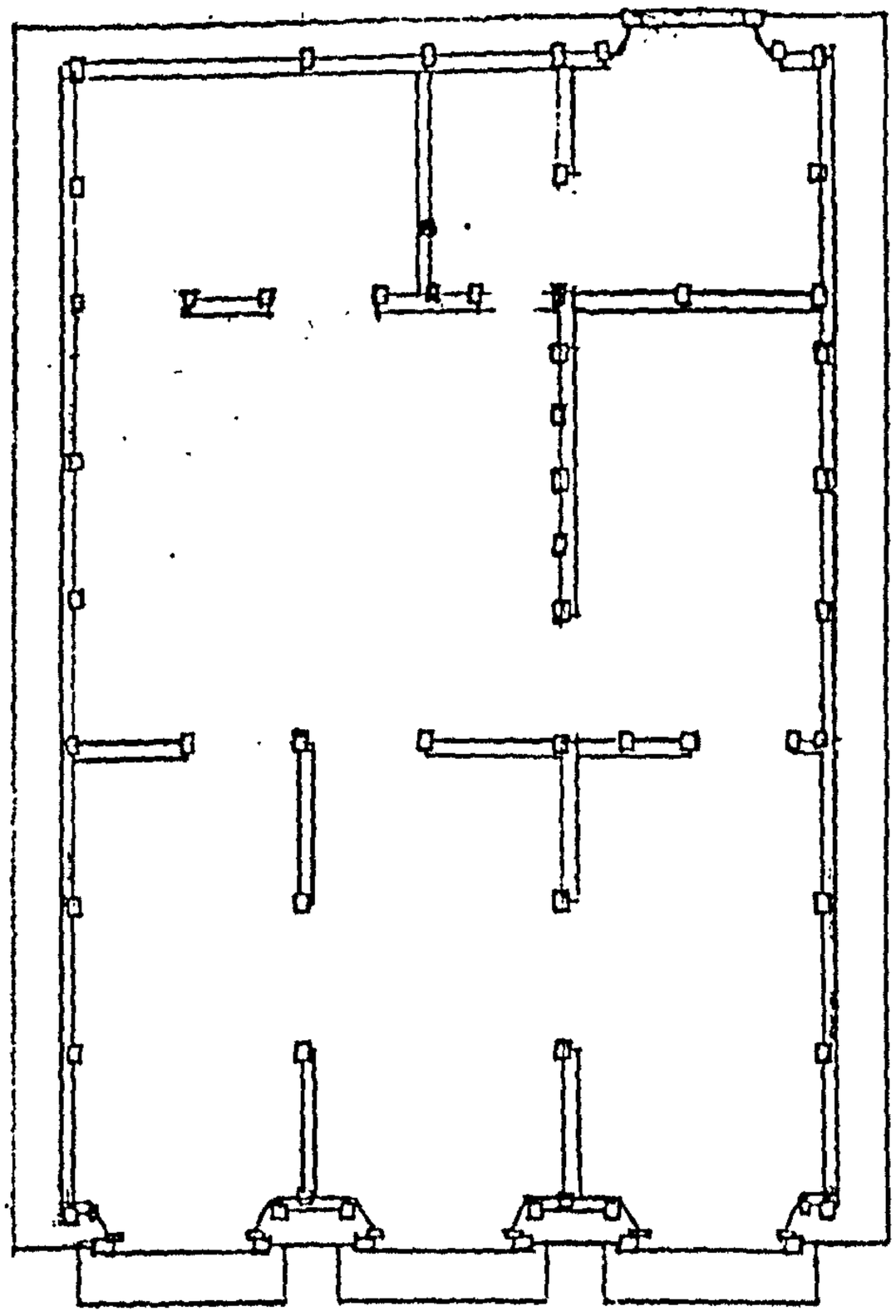


Fig.6.9-Structural plan of first, second and third floors.

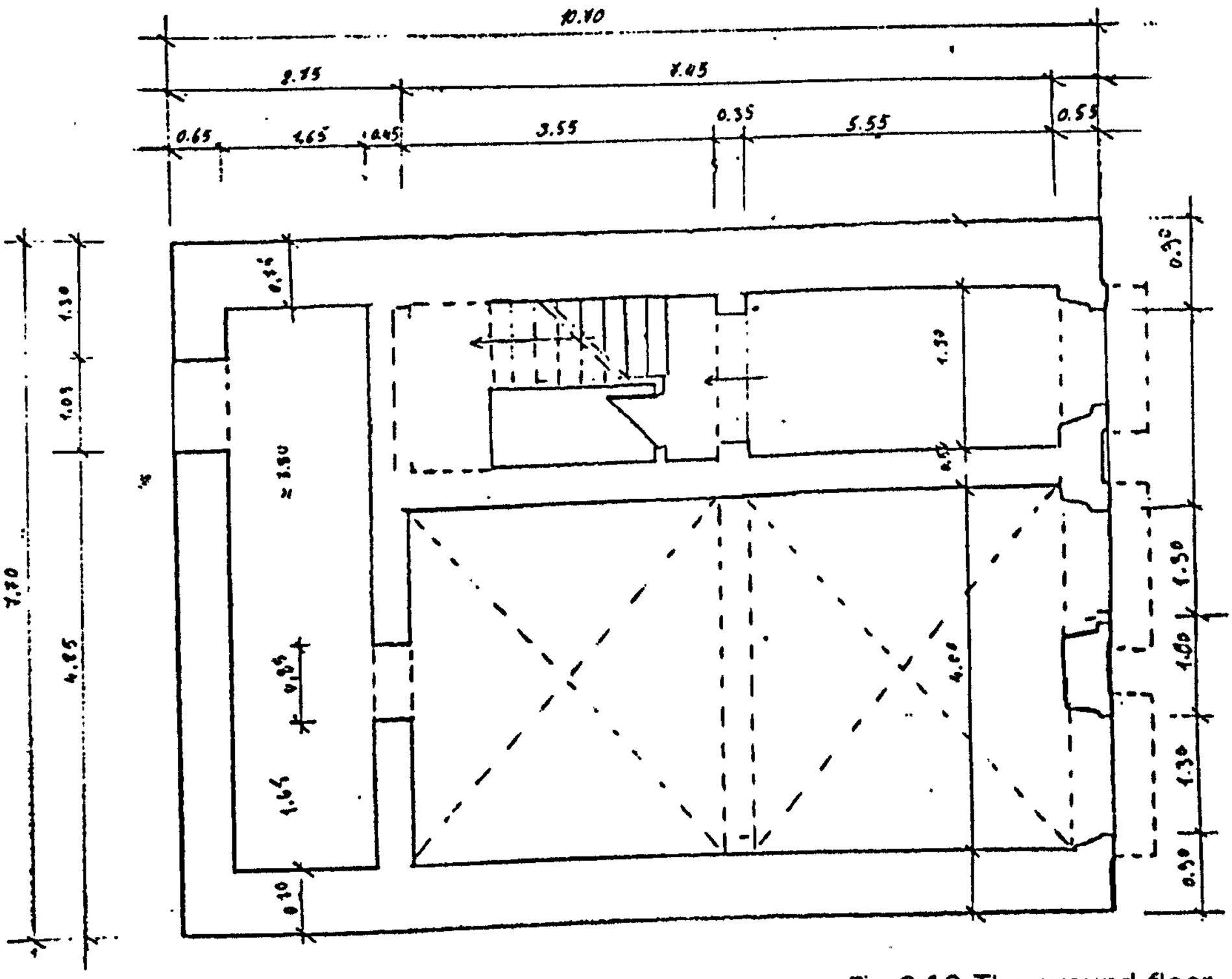


Fig.6.10-The ground floor.

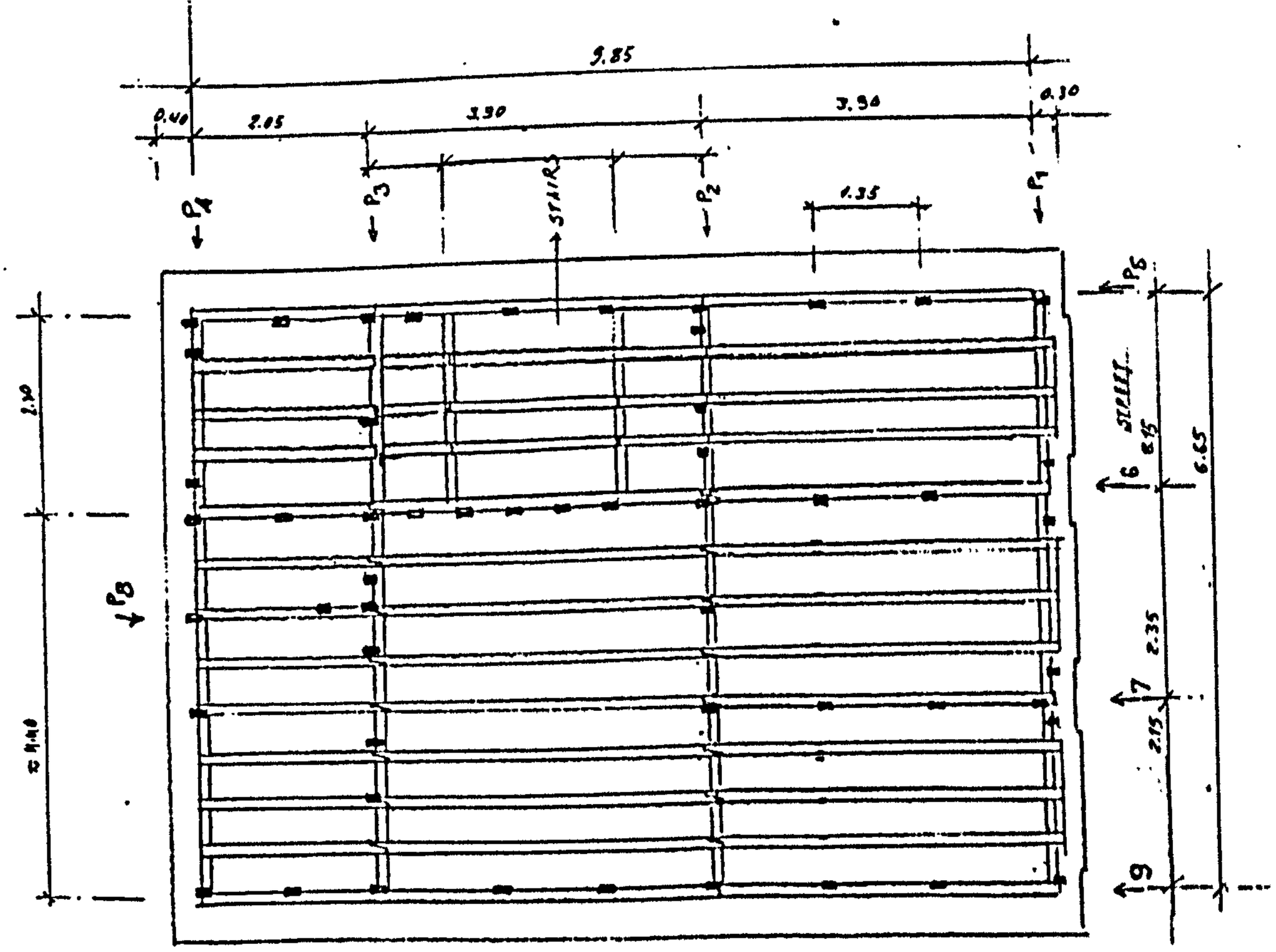


Fig.6.11-Floor joist layout

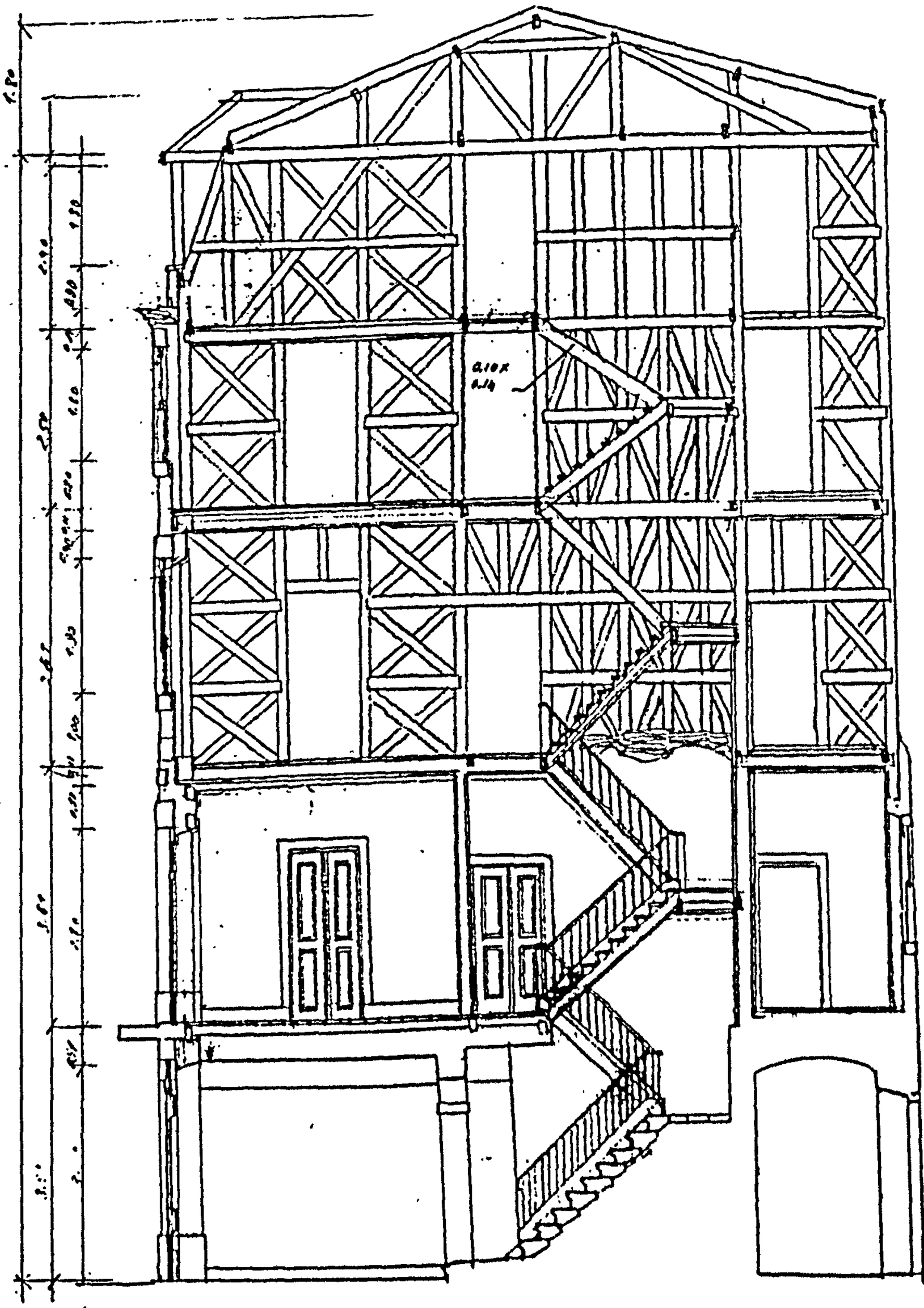


Fig.6.12-Section showing construction.

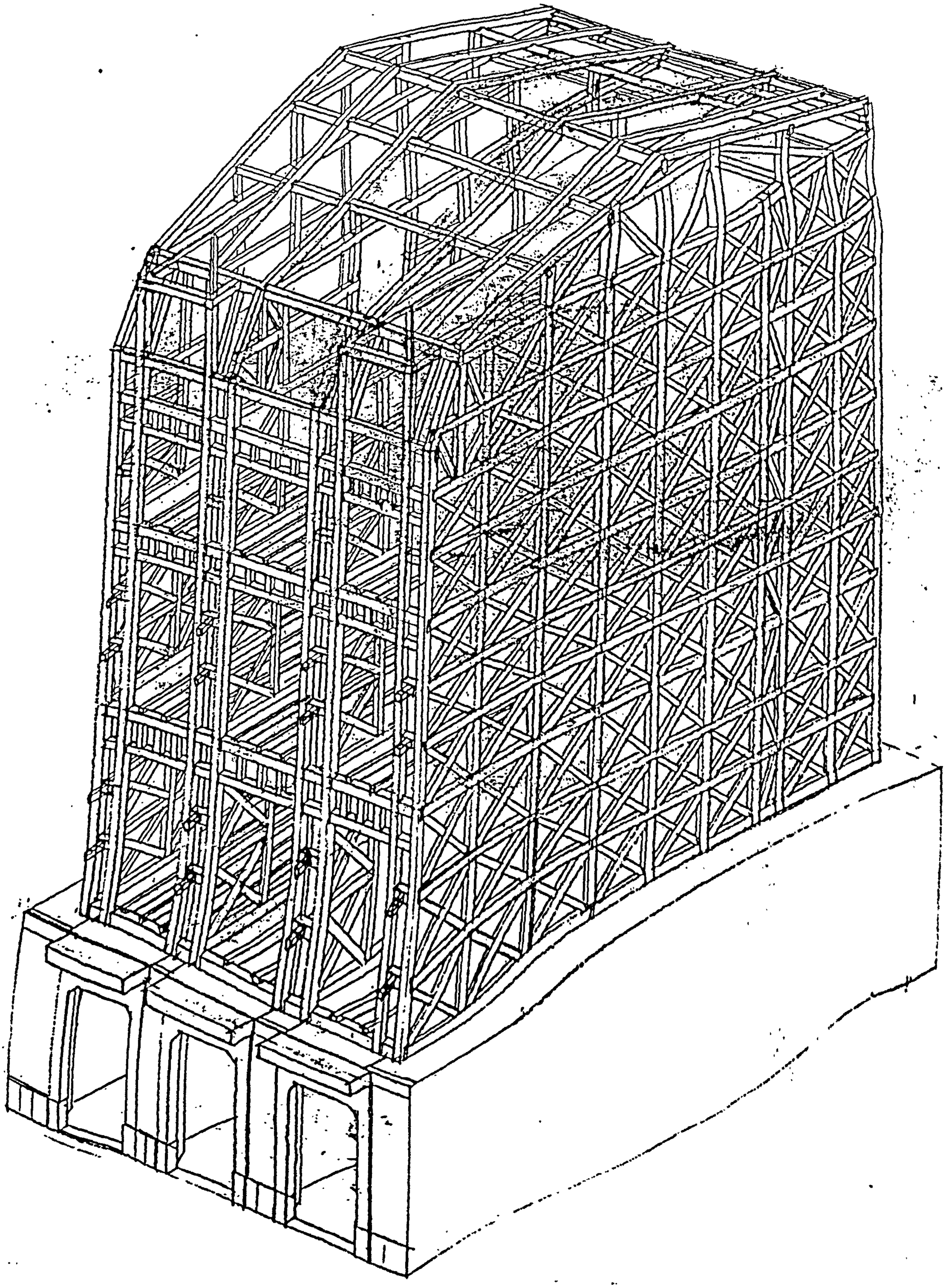


Fig.6.13-Isometric of the *gaiola*.

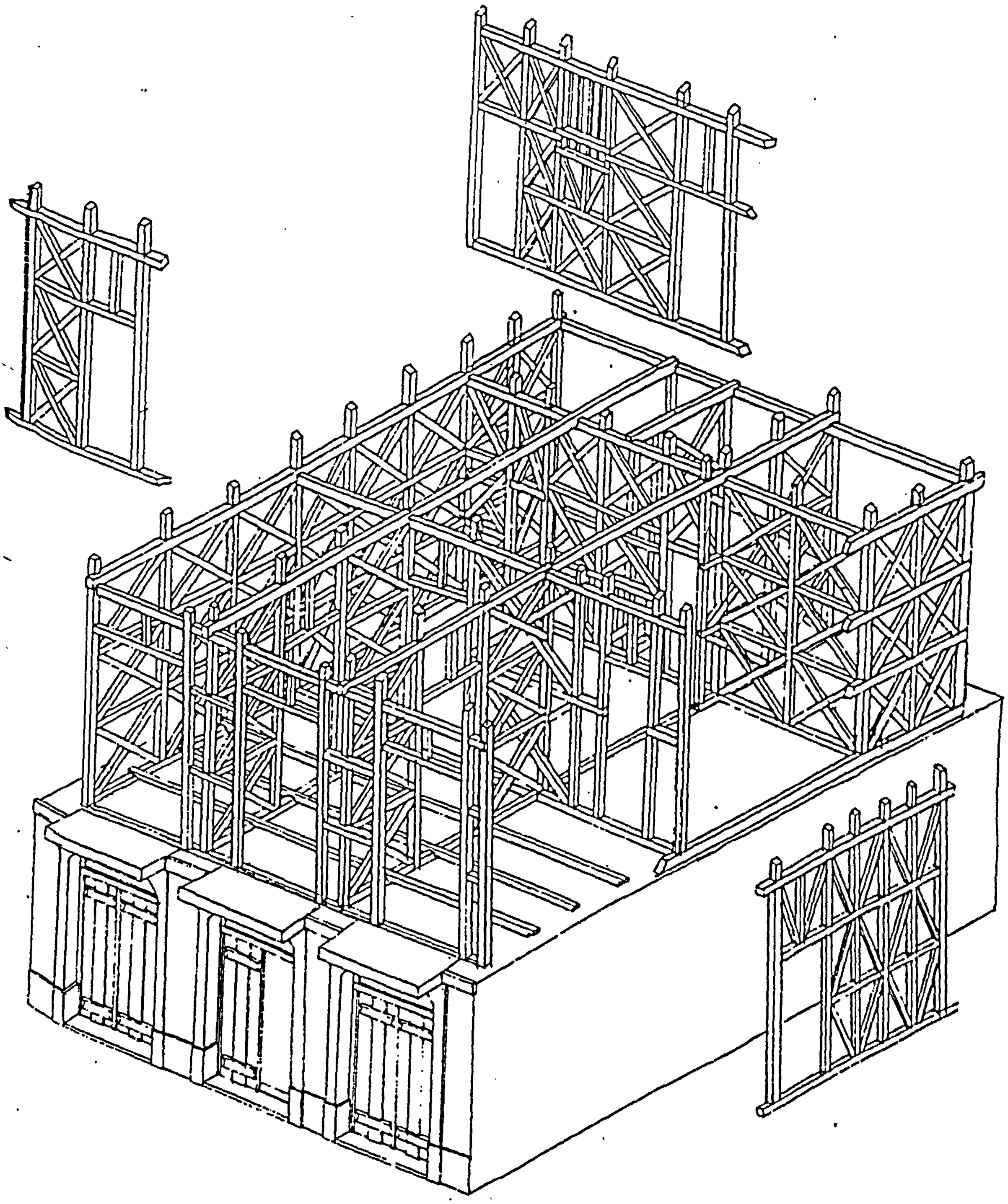


Fig.6.14-Isometric of a gaiola corresponding to the first floor

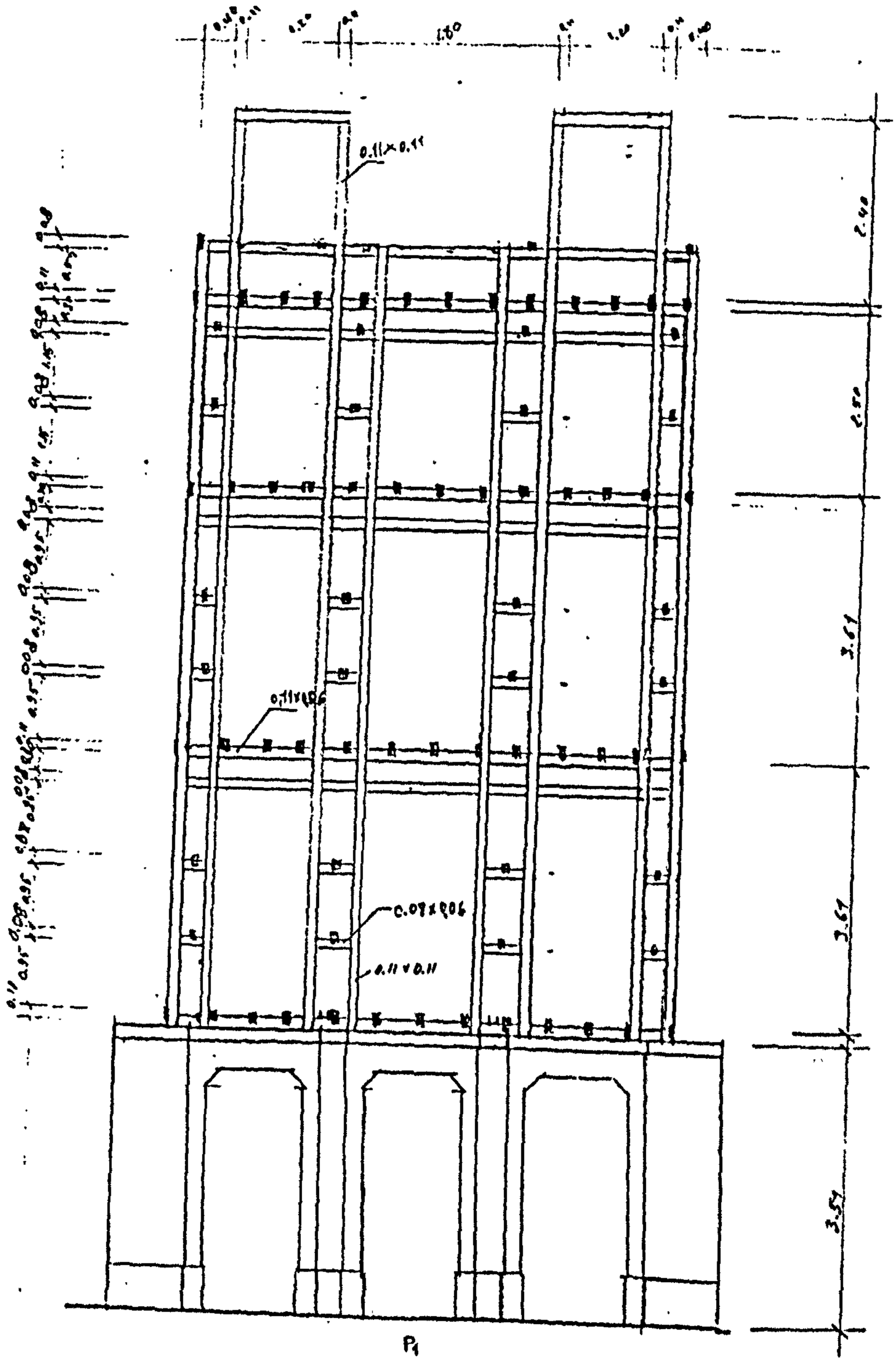
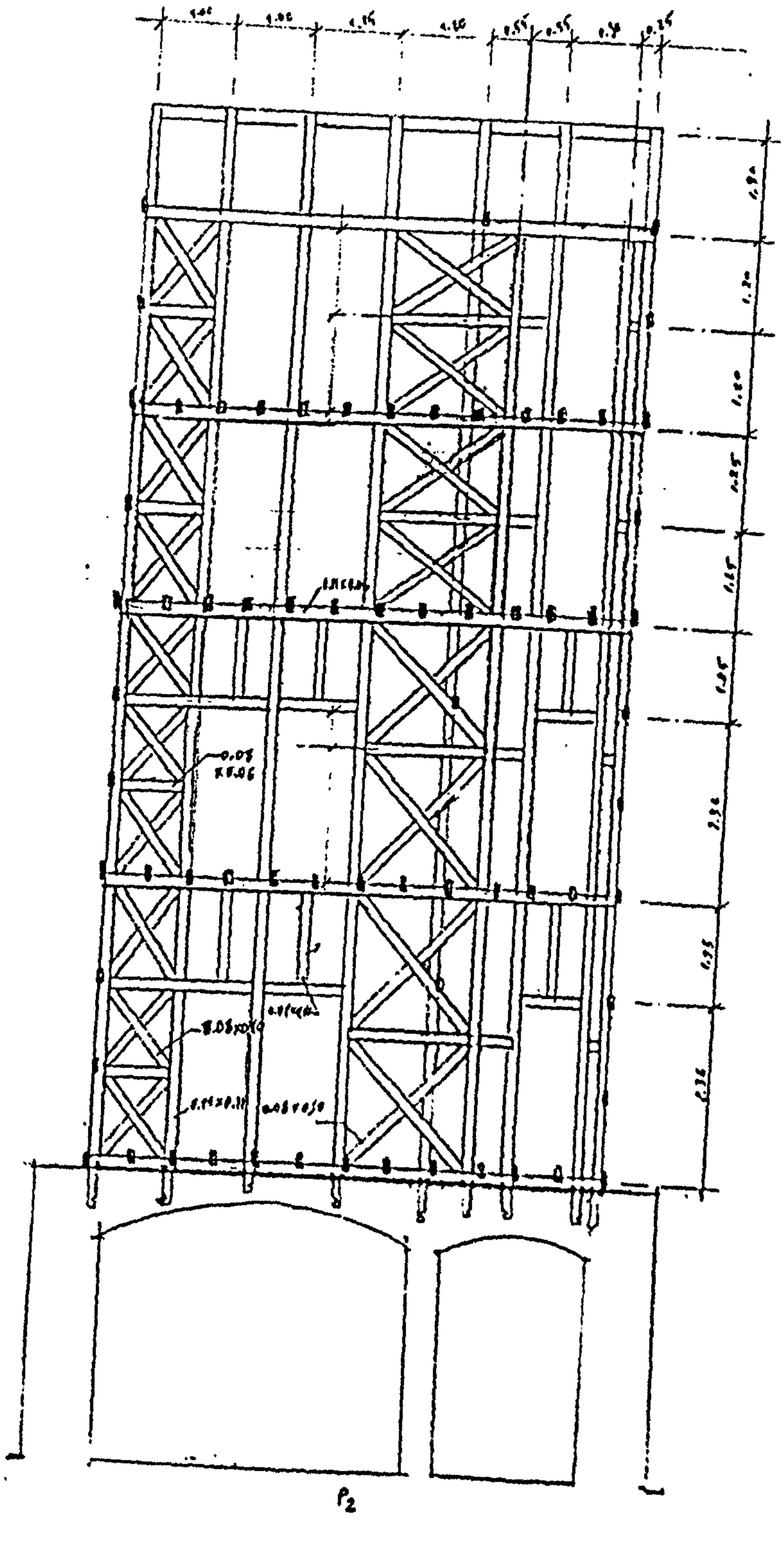


Fig.6.15-Vertical plane of gaiola, number 1, (façade).



P2

Fig.6.16-Vertical plane of gaiola, number 2

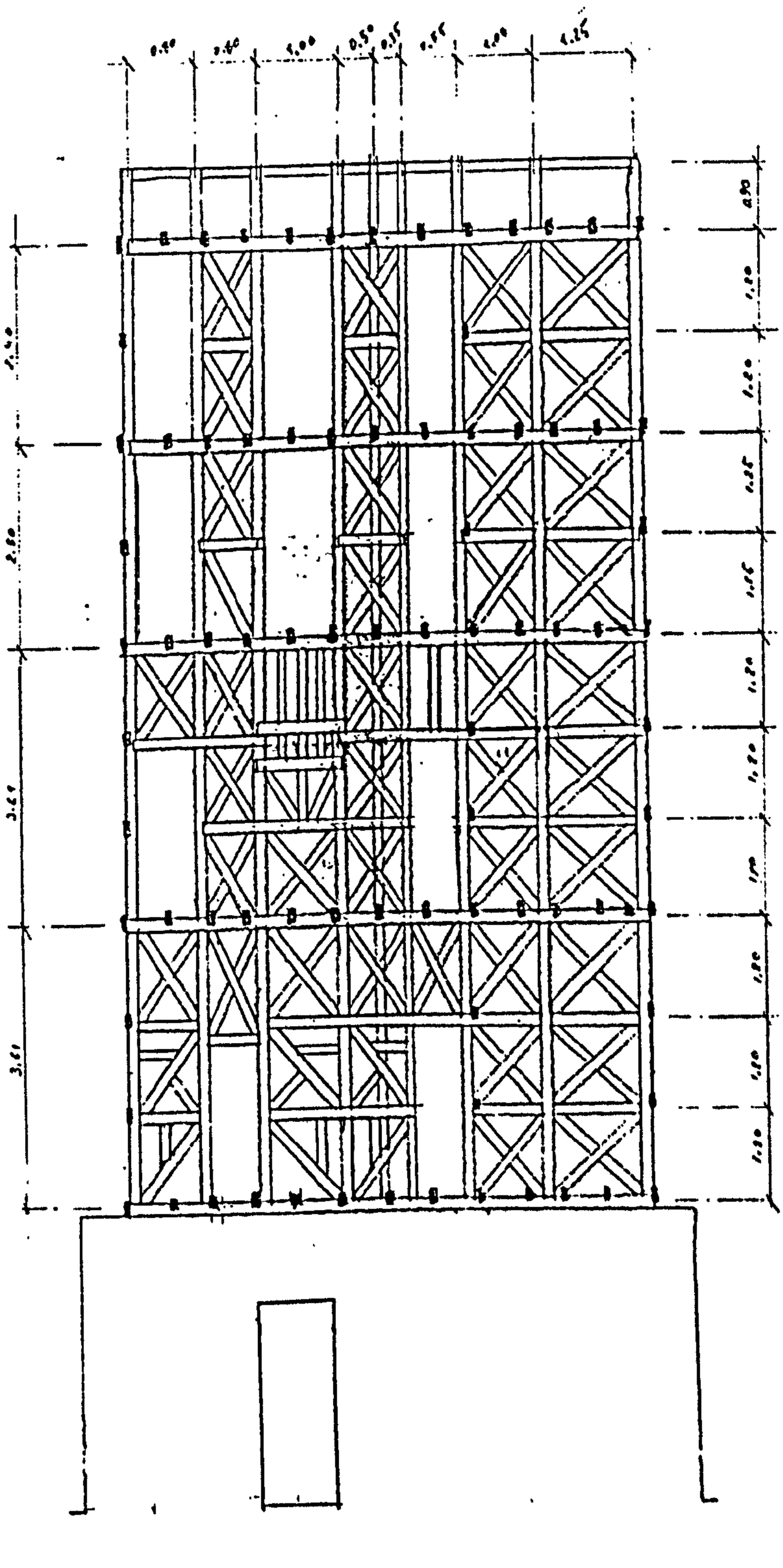


Fig.6.17-Vertical plane of gaiola, number 3

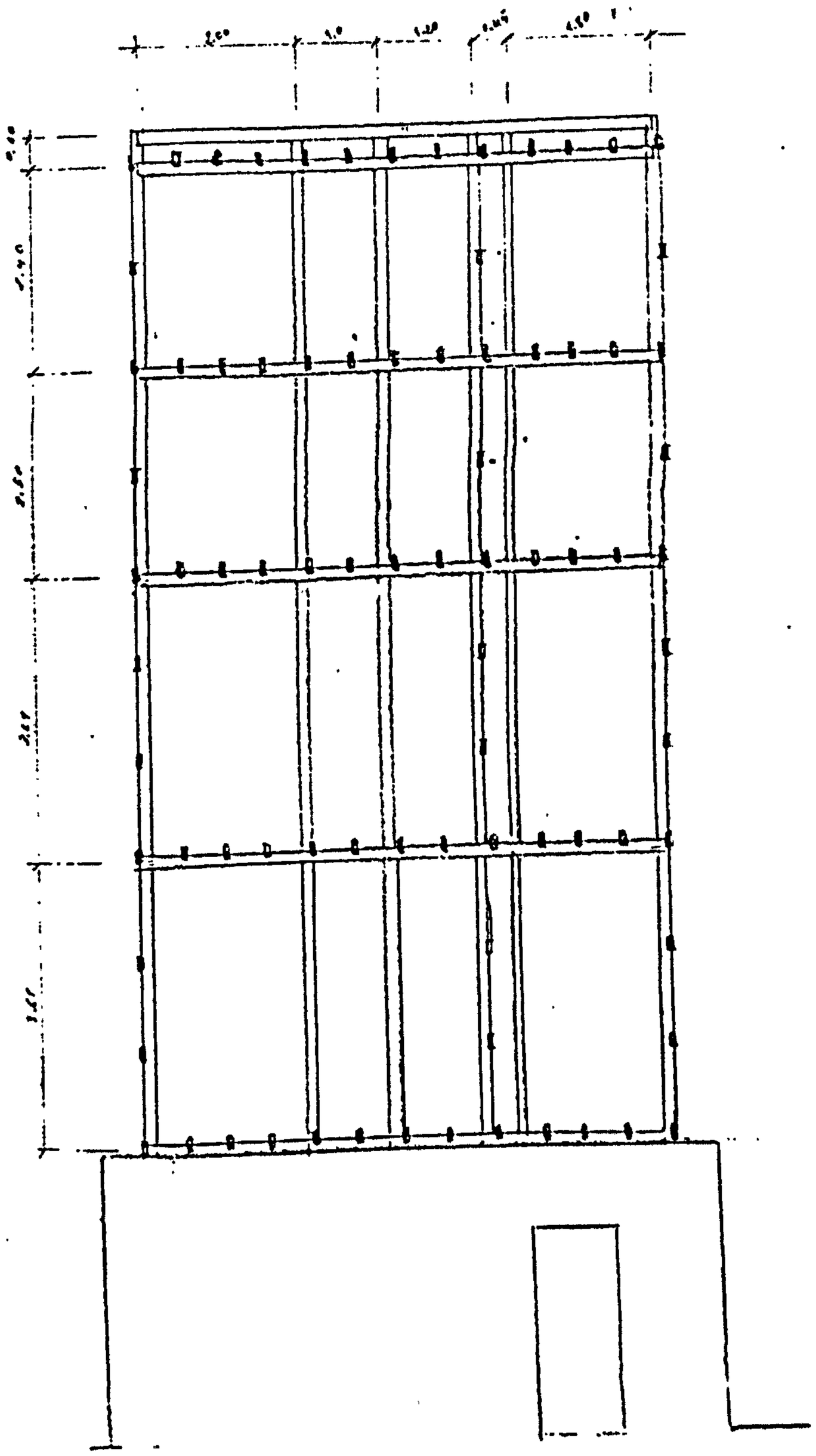


Fig.6.18-Vertical plane of gaiola, number 4

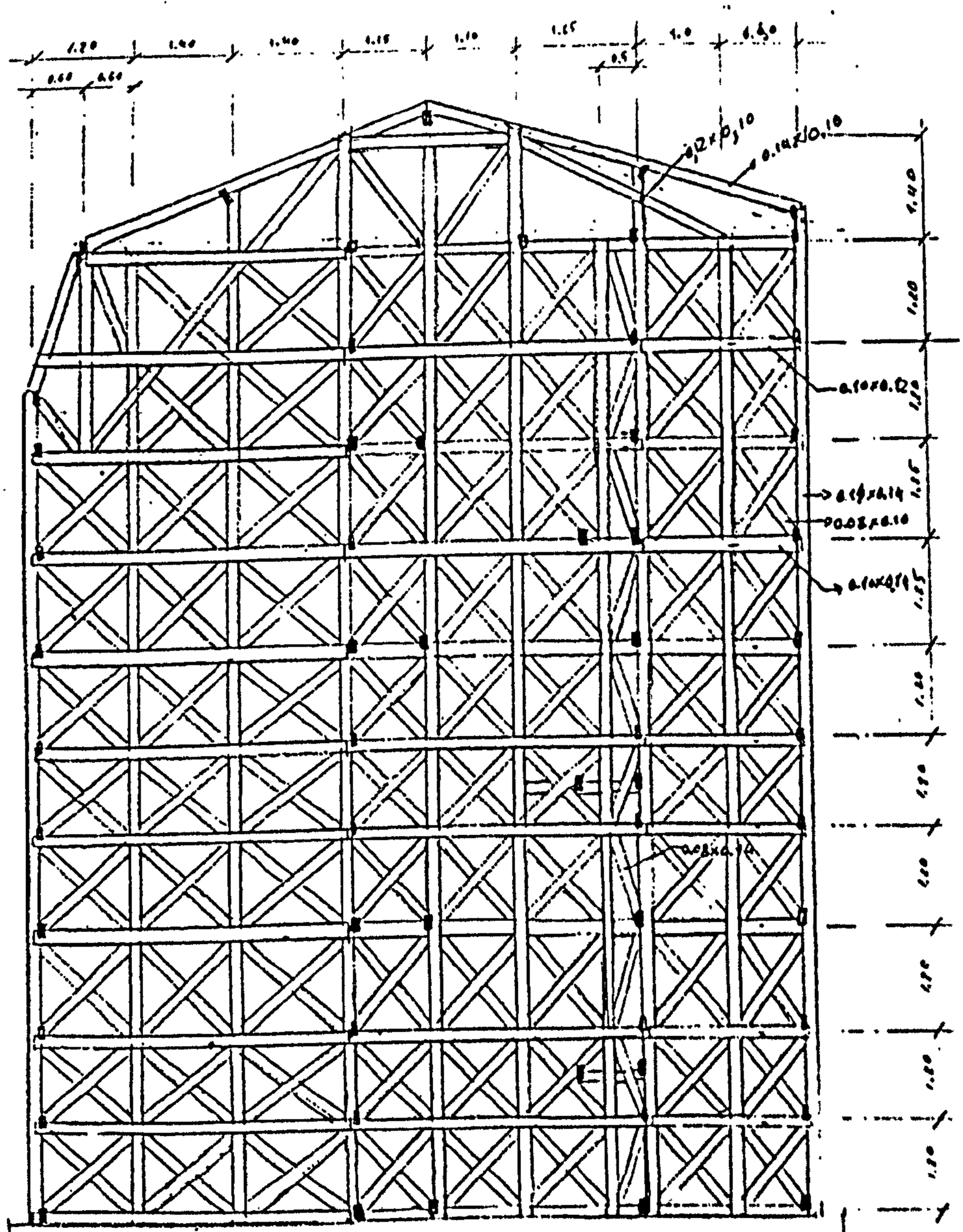


Fig.6.19-Vertical plane of gaiola, number 5

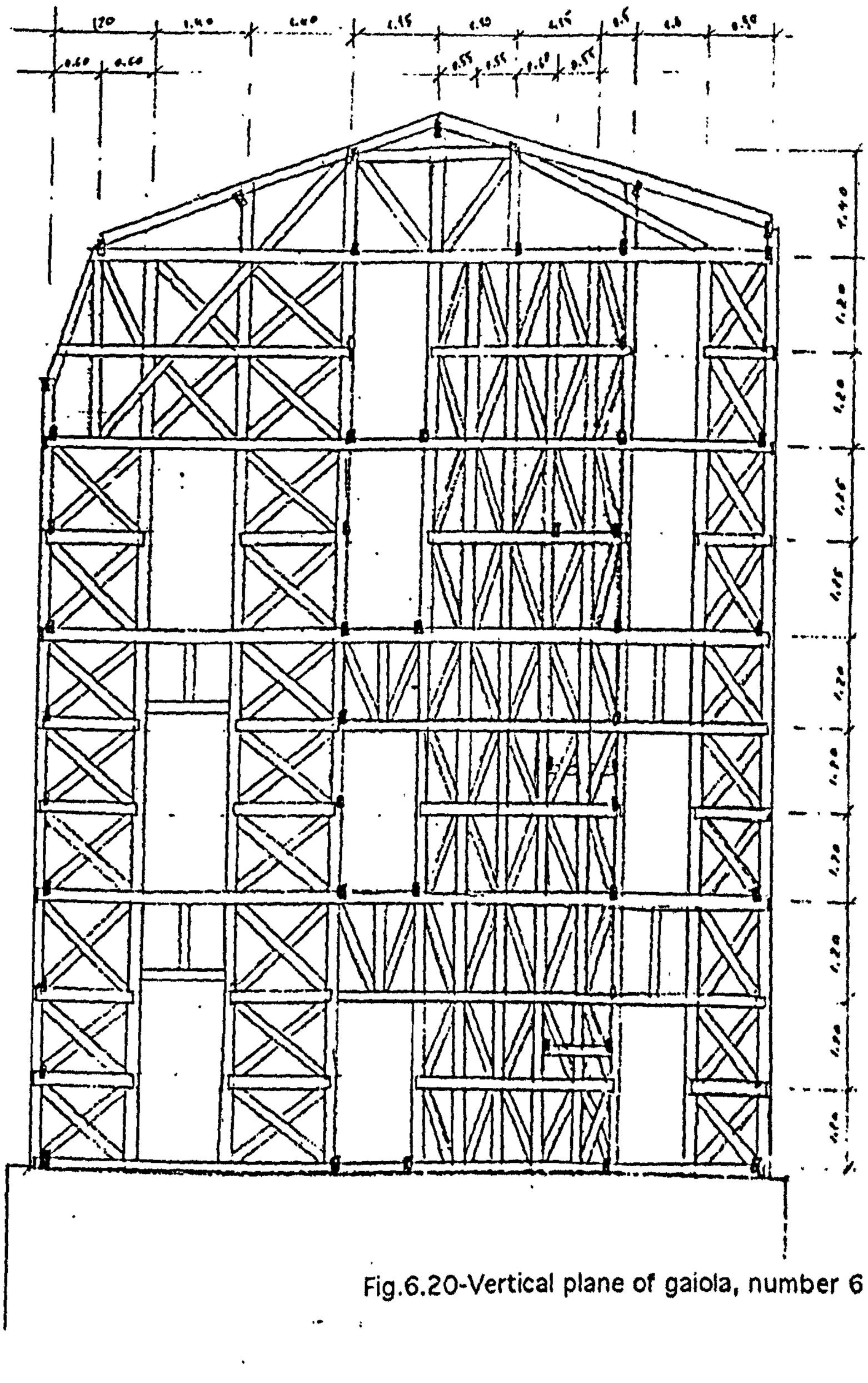


Fig.6.20-Vertical plane of gaiola, number 6

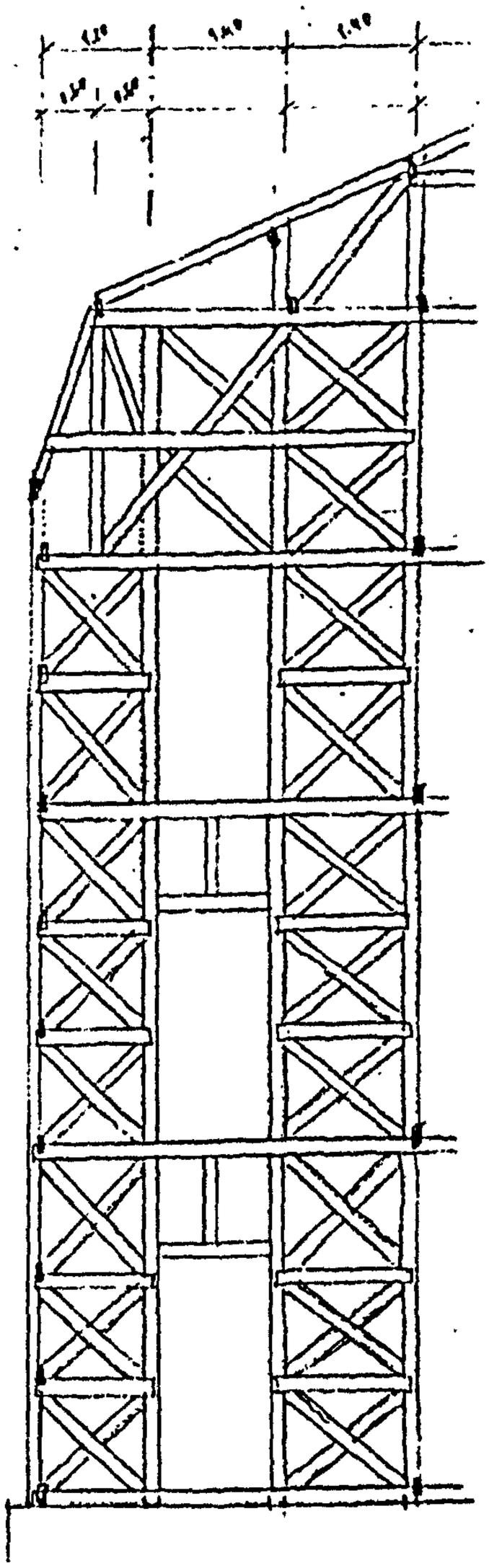


Fig.6.21-Vertical plane of gaiola, number 7

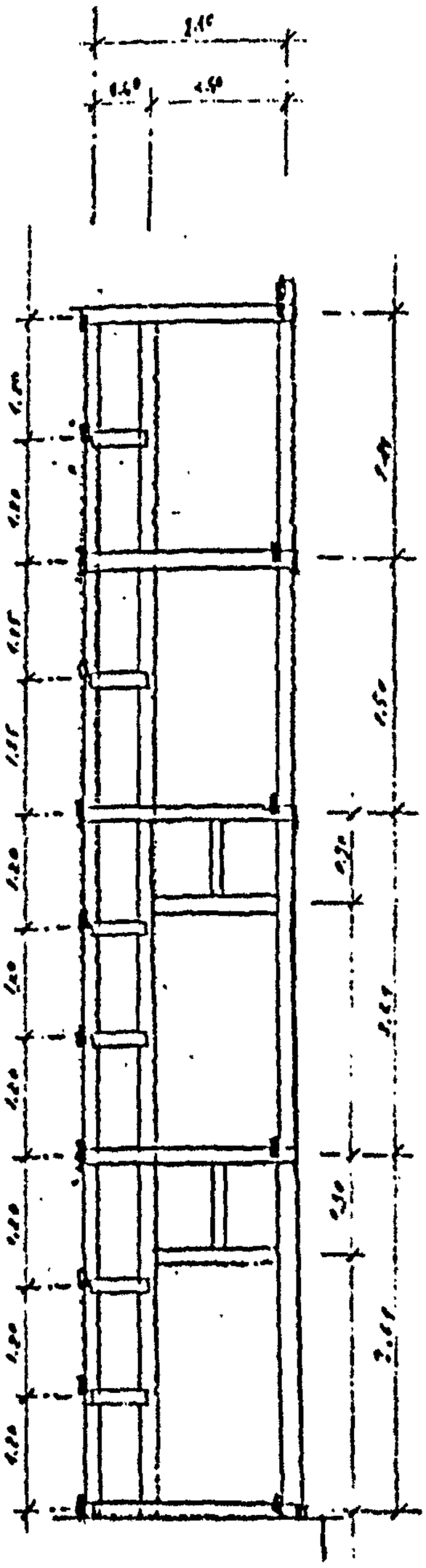


Fig.6.22-Vertical plane of gaiola, number 8

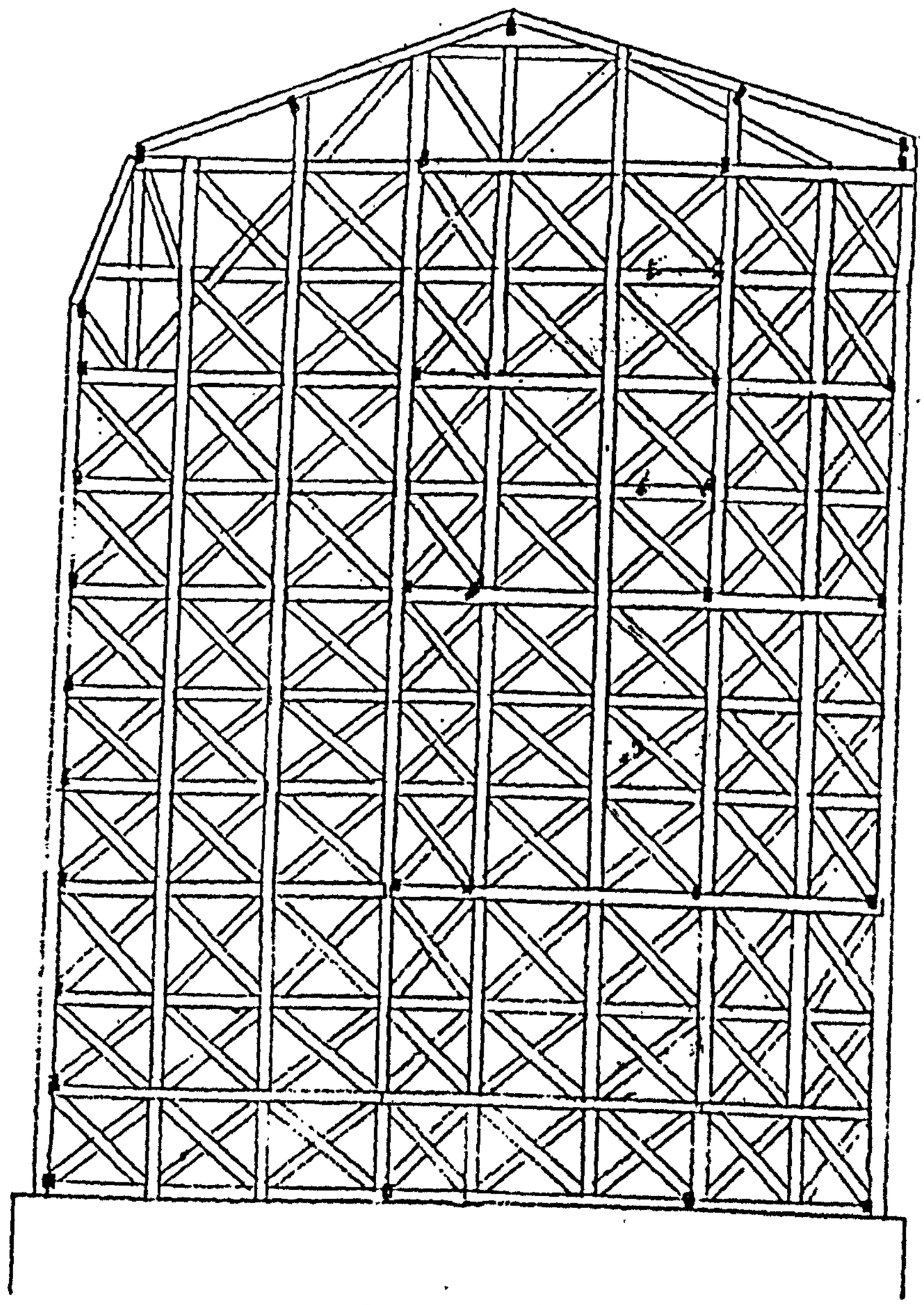


Fig.6.23-Vertical plane of gaiola, number 9

Appendix 7 - Published material

7.1 Wayne Foster and Jorge Mascarenhas, "Design and construction of the Pombaline area of Lisbon", CHS Newsletter, n.26, July 1991.

7.2 Richard Penn, Stanley Wild and Jorge Mascarenhas, "The Pombaline Quarter of Lisbon: an Eighteenth Century Example of Prefabrication and Dimensional Co-ordination", Construction History, volume 11, The Construction History Society, 1995.

7.1 Wayne Foster and Jorge Mascarenhas, "Design and construction of the Pombaline area of Lisbon", CHS Newsletter, n.26, July 1991.

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CONTENTS

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Notes from the Committee

The Management Committee's work involves two distinct aspects of the Society's affairs; the first is those matters that required regular consideration at each meeting and second, during each session, one or two major matters that have a wider importance, to do with the aims of the Society.

The regular items are ongoing things, such as the visits; where should we visit next, (any suggestions from members would be welcome), will there be something to see not usually open to view? What is to go into the Newsletter? Have we any copy available from members, is there any information we should send out? Finance, have we sufficient funds, how many members have not yet paid their subscription? Arrangements for the Annual Seminar, AGM and lecture are two more items that require continuous review, especially trying to decide on themes that will be of interest to members. Suggestions for the future would be helpful.

One of the major matters that has taken up a good deal of time recently is the promotion and publicising of the Society. With just over 200 members we have limited opportunities to recruit new members for the Committee and to expand the Society's activities. Various ways of increasing numbers have been discussed and one result is the new membership application leaflet, which has been sent to all existing members, (get someone to join) and distributed as insets in journals of societies with similar interests.

Publicity for the 1991 Seminar helps to keep the Society's name in the press.

Part of an approach to a wider audience is the 1992 joint event, being organised with the help of Jane Morley, a member in the USA, much involved with the Society for the History of Technology, Construction Industry Interest Group. The event will involve various other groups in the UK, such as the ISE History Group, the Newcomen Society and the Institution of Civil Engineers.

As part of an attempt to develop another aspect of our aims, Christopher Powell is preparing a guide to writing a history of a building firm, and the Society, in conjunction with the Business Archives Council will publish a guide one the selection of documents for preservation.

Some of these items will no doubt continue to require attention, but new subjects will come up. Next year is the tenth anniversary of the first annual meeting of the Society; any ideas for a way of commemorating the event?
Stan Smith

Understanding Structures.

Bruce Marsden, a chartered architect has sent the Editor a copy of this thesis outline for his PhD at the Bartlett School. It may be of interest to other members and is produced here in full.

The Column: A study of the growth in structural understanding in architecture from 1100 to 1860

A description within a chronological framework of the development from germinal ideas in structural thinking to the formulation of the earliest useful structural theory of the column possessing reliable predictive characteristics.

Architecturally, the dissertation encompases the times of the Gothic cathedral builders and continuing through into the period of ironwork constructors.

Most of the essential constituents of the theory originated in the studies of mechanics, strength of materials, theory of structural action, and also mathematical and experimental investigations often undertaken for purposes not directly bearing upon structural matters. Aspects of intuitive, logical, empirical, cultural, philosophical, aesthetic, architectural and structural design thinking are discussed where such impulses are evident.

The study of structural behaviour and of development in structural aspects of structural action gather momentum following the work of Galilei, who founded the science of the strength of materials using the principle of the balance and the lever. This principle, which also is an essential ingredient of the theory of structural action, had been established by Aristotle and Archimedes and treated by Jordanus and Leonardo, amongst others. Subsequent contributors who dealt with mathematical and experimental considerations include Hooke, members of the Bernoulli family, Euler, Musschenbroek, Coulomb, Young, Tredgold, and Navier, culminating in the experimental confirmation by Hodgkinson, of Euler's mathematical theory of column failure due to buckling, made available in a useful form by Rankine. Others, whose work bears upon the development include Vitruvius, architects of the Gothic cathedrals, Alberti, Bèlidor, Laugier, Bage and Strutt, Telford, Girard, Rondelet, Barlow, Rennie, Robison and Viollet-le-Duc.

Not only were the threads of conscious learning from experience, experiment and abstract theory developed independently but there is very little evidence of interaction between structural theory as a whole and architectural and structural design until the threads became interwoven towards the close of the period defined in this study.

For those readers who wish to learn more of the project a copy of the contents of the dissertation is available from the Editor. Alternatively, contact can be made with Mr Marsden at his office at 35 Alfred Place, London WC1E 7DP.

Publications received

VAG Newsletter. June 1991.
Vernacular Architecture Group List of Members at June 1991.
Business Archives Council Newsletter. June 1991.
Business Archives Council. Annual Report 1990/91.
Business Archives: Principles and Practice. May 1991.
Business Archives Council. Minutes of the Annual General Meeting held on Thursday 5 July 1990.

Design and construction of the Pombaline Area of Lisbon

Wayne Foster contributes the following item which is based on studies carried out with Jorge Mascarenhas who is studying for a MPhil at the Polytechnic of Wales.

Introduction

Following the massive earthquake of 1755, the commercial heart of the city of Lisbon was re-built. The Marquis of Pombal, Minister of the crown, was responsible for the plan. The result was a fully developed modularised urban design. The buildings are an extension of the system. Speed of re-construction was a guiding principle along with the need to construct buildings that could withstand future seismic activity and prevent subsequent firespread. The result is an architecture as cold as ice but a building form and system which may be described as proto modern in many ways. The research being undertaken is in two main parts:

- The urban design
- Buildng form and construction

Lisbon's planning codes do not protect the area in any way and the buildings may be considered at risk of unsympathetic redevelopment and in some cases neglect.

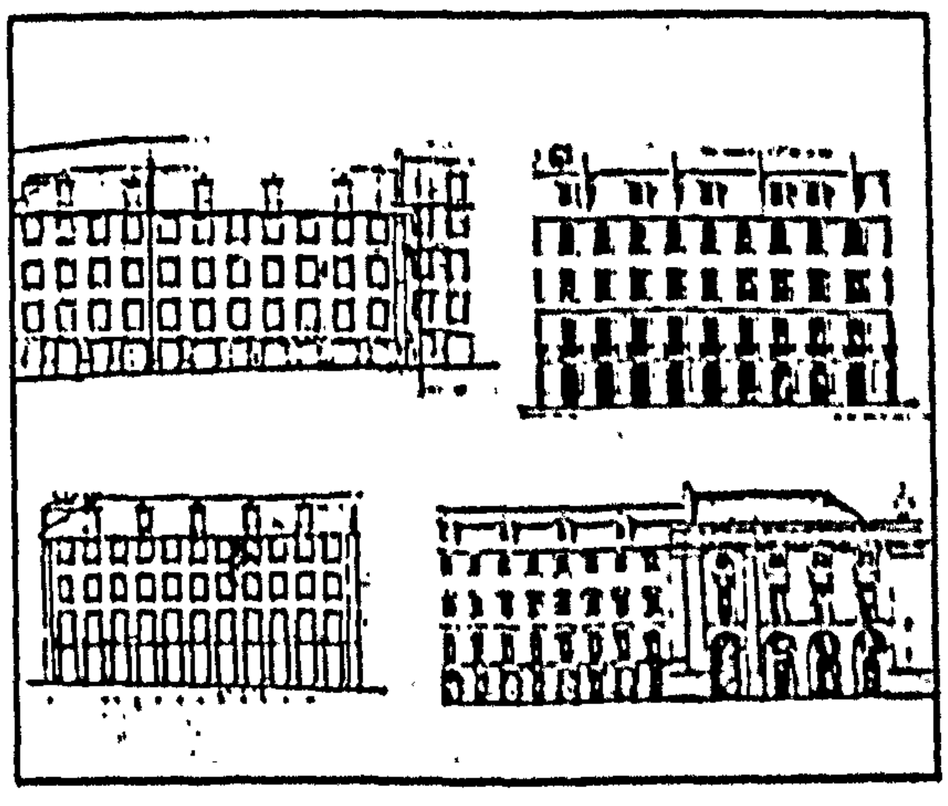
Brief background

The city of Lisbon, like some other European cities, was founded and developed on a defensible hill alongside a large estuary.

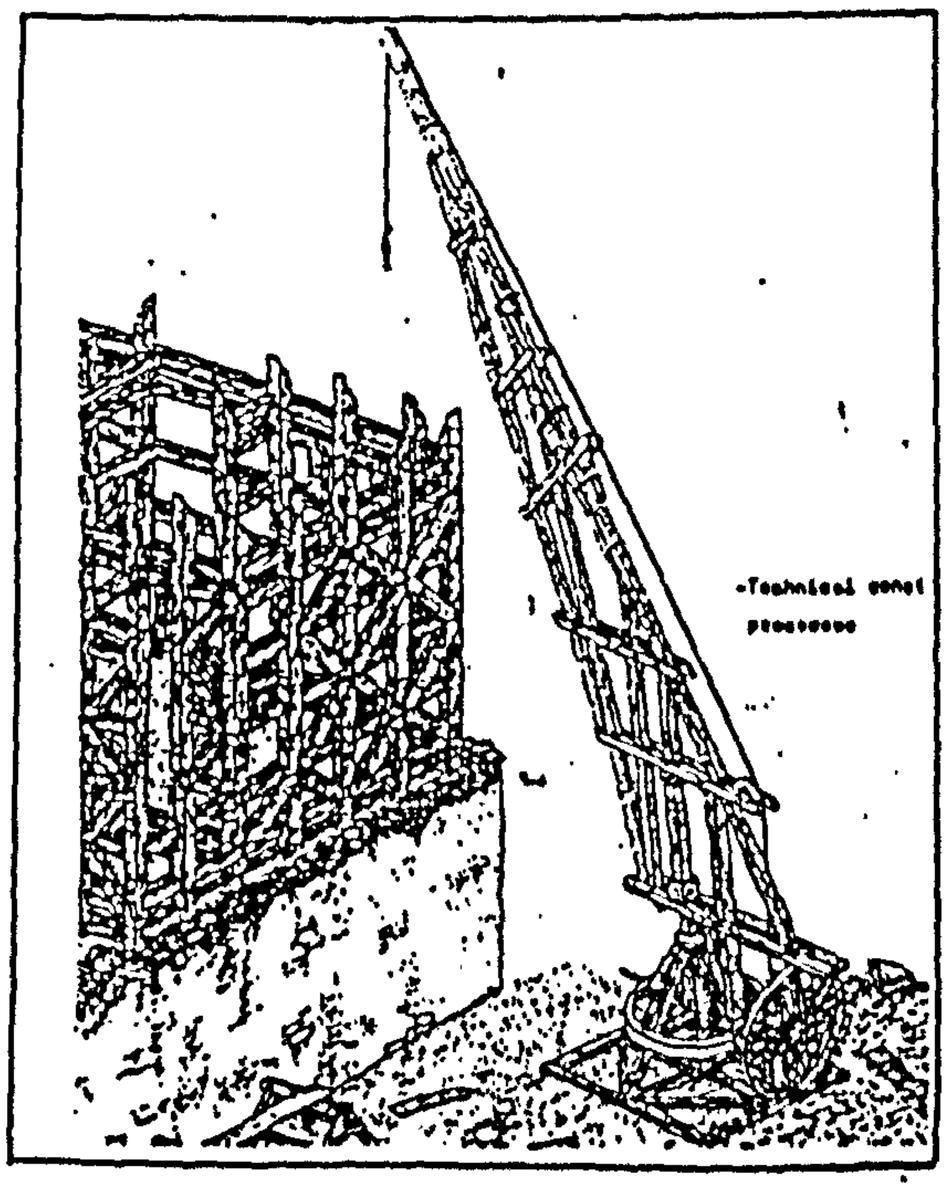
By the 18th century two main squares, the Paco Real and the Rossio were connected by a network of narrow mediaeval lanes and alleys. On the 1st of November 1755 Lisbon was subjected to massive tremors. The subsequent effects destroyed the commercial centre of the city.

Urban plan

Under Pombal and the chief engineer to the crown, Manuel de Maia, three teams produced six different redevelopment plans. In spite of difficulties of property ownership the scheme chosen was based on a rigid orthogonal network of large city blocks. It was based on a sophisticated approach to the economics of retail and residential development.



Building form and construction
The buildings are simple, repetitive and (for the period) very plain. However, they are constructed using an anti-seismic structural frame or cage made of softwood. The whole constructional system is based on modular measurement and the introduction of a set of building regulations. Components were prefabricated wherever possible and the construction process was designed for ease and speed of erection.



The Museum of Brighton in the Lanes

A fund raising campaign launched by the Arts & Leisure Department of the Brighton Borough Council has as an objective the creation of a museum entirely devoted to development of Brighton as a resort, encompassing its traditions, its history and its people. The Holy Trinity Church in Ship Street will be the home of the museum and it is due to open in April 1994.

Needless to say the museum requires extensive funding and the campaign is intent on raising £1.2M.

The museum is seeking the Society's support in helping to raise funds and they suggest this might be carried out in two ways.

'Adopt-a-Brick' is a scheme exclusively designed for individuals who wish to continue their involvement, or to join the scheme at a later date; there will also be an opportunity to adopt prints and other small artefacts, starting at £7.50 upwards.

The second means by which the Society is asked to support the museum is in sponsoring a display.

For those who wish to support the 'Adopt-a-Brick' initiative are invited to send their donation to Sarah Carthew, the Museums Development Officer at the Royal Pavilion, Art Gallery & Museum, Brighton, East Sussex BN1 1UE.

FMB Celebrates 50 years

The Federation of Master Builders, one of the two major trade associations representing builders, celebrates its 50th anniversary this year and incorporated in the July issue of 'Master Builder', is a pull-out supplement which provides a history of the Federation.

Although only of relatively recent foundation the development of the Federation makes interesting reading, not least in relation to its relationship with the NFBTE or Building Employers Confederation as it now is. The motivation for the creation of the Federation is summed up in a remark made by the solicitor, Leslie Venning, who as Secretary of the Chamber of Commerce in Islington felt that the problems of representation for smaller builders in London should be addressed. At their second meeting, on 6 November 1940 at which 37 builders were present Mr Venning said 'There is only one existing organisation for builders and that is the London Master Builders Association. It has about 250 members who consider they are the elite of the industry; I have even seen letters rejecting applications from small builders.

My conclusion is that the LMBA gives the impression that it wants to retain its exclusive character'. This approach generated a firm resolve by the smaller builders to create their own organisation and thereby seek adequate representation. Despite this, overtures were made by both sides throughout the succeeding years in an attempt to achieve some rapprochement between the two Federations and thereby ensure a single point of reference for builders. The fact that both organisations are still in existence demonstrates how these initiatives came to nothing.

The fascinating account provides a valuable insight into those issues which affect builders and in particular those relating to wage bargaining, industrial relations problems and training, and the fight to obtain representation on CITB.

7.2 *Richard Penn, Stanley Wild and Jorge Mascarenhas, "The Pombaline Quarter of Lisbon: an Eighteenth Century Example of Prefabrication and Dimensional Co-ordination", Construction History, volume 11, The Construction History Society, 1995.*

CONSTRUCTION HISTORY

Journal of the Construction History Society

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Books for review, and book reviews, should be sent to Robert Thorne, Institute of Historical Research, Senate House, London WC1E 7HU, Great Britain.

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The Pombaline Quarter of Lisbon: an Eighteenth Century Example of Prefabrication and Dimensional Co-ordination

RICHARD PENN, STANLEY WILD AND JORGE MASCARENHAS

Introduction

The Pombaline quarter of Lisbon in its present form originated as a complete rebuilding of 19.04 hectares of the city after it was destroyed in 1755 by a disastrous earthquake. The whole area is densely built up with mainly five-storey high blocks which were originally flats and shops. The original number of dwellings cannot be stated exactly as some of the buildings have been rebuilt completely internally, but it is estimated at 1980. This gives a density of just over 100 dwellings to the hectare. The quarter has many unique characteristics, some of which anticipated later developments by a century or more.

The City and the Earthquake

The area now known as the Pombaline quarter was originally a tidal inlet which became silted up in pre-Christian times, and so the ground consists of unstable alluvium. It was incorporated into the city in the Middle Ages, and by 1650 it was covered with an irregular network of streets and alleyways winding between equally irregular buildings, all situated between two large squares, the Rossio to the north and the Praça do Comércio to the south. This pattern persisted until 1755 (Fig. 1).

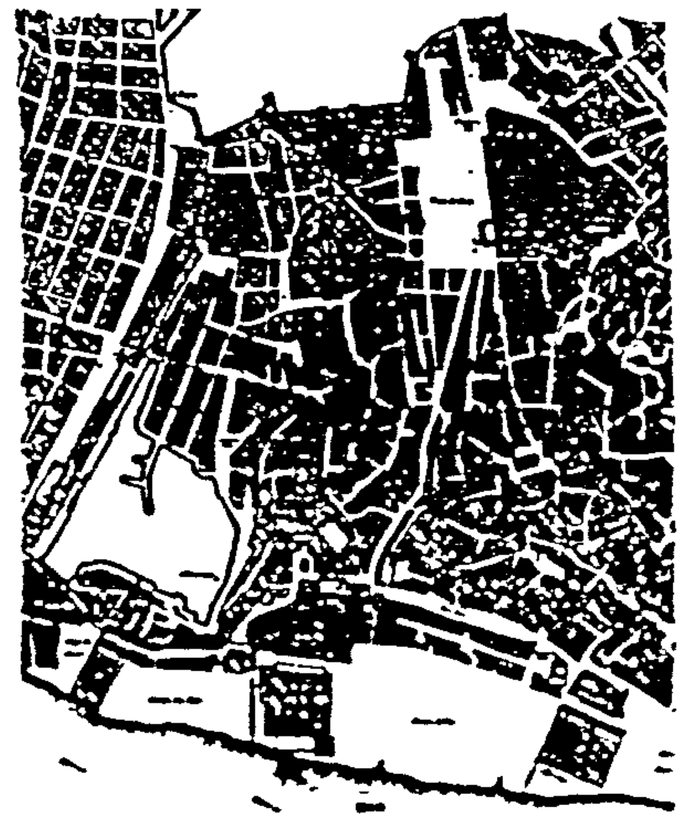


Fig 1: The city centre destroyed by the earthquake of 1755, as shown on João Nunes Tinoco's plan of 1650. (Reproduced with permission from José-Augusto França, *Lisboa Pombalina e o Iluminismo*, 3rd edition, Livraria Bertrand Editora, Lisbon, 1983, p 26).

The earthquake of 1 November 1755 registered between 8 and 10 on the Mercalli scale and lasted for seventeen minutes. Its epicentre was south of Lisbon near the Algarve, but its destructive effects were worst in Lisbon, and especially in the area later known as the Pombaline quarter, because of its dense population and unstable ground conditions. It was accompanied by a tidal wave and followed by a fire, which lasted for six days and destroyed all the buildings in the Pombaline quarter which had survived the earthquake. The narrow, winding streets did not enable the inhabitants to escape quickly enough, and about 10,000 are thought to have died. Panic overtook many of the survivors, including the King, who sought refuge away from the city.[1]

Fig 2: After the earthquake of 1755: the adopted plan of the reconstruction. E. Santos, Poppe, Plan number 5 (Reproduced with permission from José-Augusto França, *A Reconstrução de Lisboa e a Arquitectura Pombalina*, 3rd Edition, Biblioteca Breve, Vol 12, Lisbon, 1989, Plate 7).

Planning the Reconstruction

The Marquis of Pombal, a Government Minister, remained in the city and organised emergency measures. He invited a military engineer, Manuel da Maia, to oversee the reconstruction of the city. Along with his team of architects and engineers, da Maia in may ways personified the Age of Enlightenment; he was above all rational and practical. He presented reconstruction proposals to the Senate in three stages, and at each stage, from a number of approaches, the one chosen was the boldest and the most rational. As a result, in May 1758, a licence was granted to begin reconstruction of the city, including the Pombaline quarter. The reconstruction of this area was based on a completely new rectilinear plan (Fig. 2) and on a strict set of rules governing the design and construction of the new buildings.

The Need for Earthquake Resistant Construction

Da Maia and his team were determined to avoid a repetition of the 1755 disaster. This was one of the reasons for the choice of a rational, rectilinear layout with straight, wide streets which would enable people to escape quickly to the safety of the Rossio or Praça do Comércio squares in the event of an earthquake. The architectural details of the buildings were to be simplified to eliminate features which could in any way endanger passers by or promote the spread of fir (Fig. 3). However, as well as minimising the number of deaths which would be caused if buildings did collapse, they also attempted to reduce the possibility of buildings collapsing in the first place by using earthquake resistant construction. It had been noted that many timber-framed buildings in the Castle Hill area of Lisbon had survived the earthquake intact, so a system of timber-framed construction was adopted for the reconstruction, albeit in combination with masonry (Fig. 4). This alone made the adoption of some degree of modular planning inevitable in the design of the buildings To increase the stability of the buildings the façade openings were to be perfectly aligned and the overall height of the buildings was limited[2] adding further to the uniformity of the buildings. The use of prefabrication and mass production for some of the components could have been another reason for the use of modular planning as a means of ensuring dimensional co-ordination, on a large scale and in a way that anticipated much later developments.

Fig 3: Pombaline rentable buildings: Figueira Square. (Drawing by Jorge Mascarenhas).

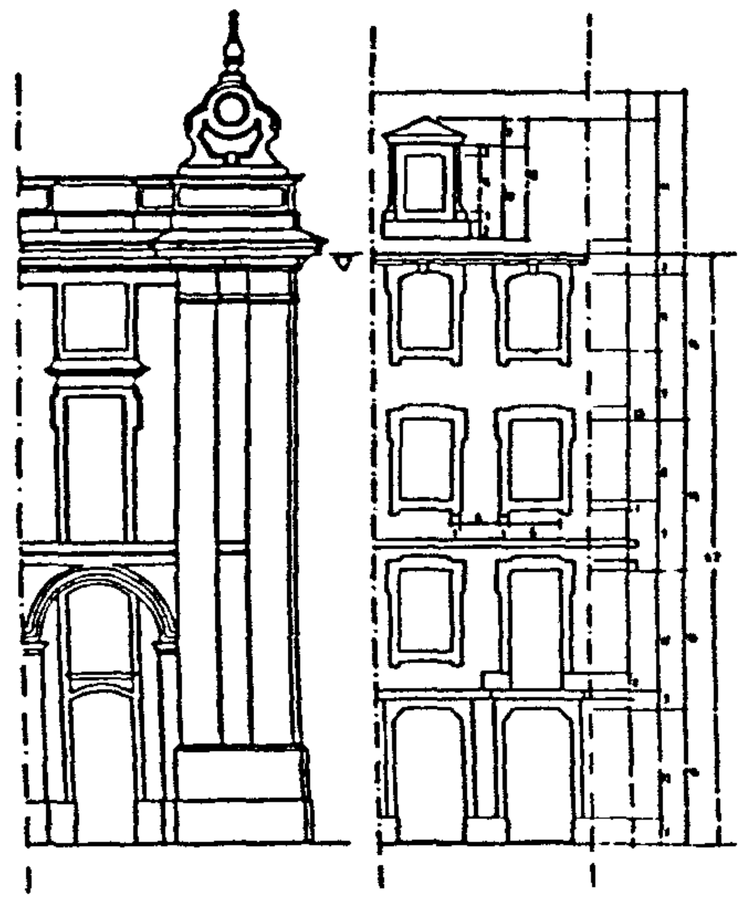


Fig 4: Typical construction of a Pombaline rentable building 60 Ouro Street. (Drawing by Jorge Mascarenhas)

The Adoption of Prefabrication

Up to the time of the earthquake, the construction of buildings in Lisbon tended to take a long time. Usually as the work progressed, specialised craftsmen on site or in small workshops produced components to order. An example is the building of the Palace at Mafra between 1717 and 1735, for which there was a specific, precise and limited production of components in workshops, many of them on site whose function changed as the work progressed[3] Professor França[4] and the late Portuguese architect Porfirio Pardal Monteiro[5] have both suggested that a decision was made to turn to prefabrication and mass production in answer to the need to rebuild the city quickly. These suggestions were no doubt influenced by the repetitive and standardised nature of the buildings, but the main basis for them appears to be an oral tradition passed down by Pardal Monteiro's ancestors. A letter has been received from Pardal Monteiro's nephew, Antonio Pardal Monteiro, confirming this: an English translation is included as Appendix 1.

It is also known that in the years immediately following the earthquake, the King and the Marquis of Pombal took measures to encourage the mass production and stockpiling of building materials and manufactured items A decree passed on 15 May 1756[6] states that *"given the serious shortage of wood, roof tiles and bricks, and in order to facilitate the rebuilding of properties....all the materials and merchandise produced in the country's factories would have the same right to be brought into or out of the country without embargoes or debts, which had been conceded to products of the Grão Para and Maranhão Companies...."* This decree would have given general encouragement to building materials manufacturers to mass produce and stockpile, by giving them easier access to overseas markets. However, a licence of 12 May 1757 more specifically encouraged manufacture of materials and components for the home market. *"As King, I hereby declare this licence to be lawful, considering its utility, being for the rebuilding of the City of Lisbon, the multiplication of the factories of lime, bricks, wood and*

stone, and to ensure an abundance of these materials at fair prices....Reason and experience show that duties and coercion discourage all those who produce and transport the above mentioned materials....in order to prevent intermediaries and speculators, fabrication, transportation and competition are to be promoted....I establish that with the desired duplication, no longer may anyone embargo or prejudice those who fabricate or order to be fabricated, transport or order to be transported...."[5]

The references to "*factories of....wood and stone*" and "*fabrication*" in relation to wood and stone, suggest that mass prefabrication of wood and stone components was envisaged, as opposed to mere extraction and processing of the materials.

An edict of 29 June 1757 states "*His Majesty, considering it to be in the public's interest and for the benefit of residents and manufacturers that prices be maintained....the treasury should proceed to purchase all materials produced in the kingdom that do not find immediate buyers and should stock up, supplying when necessary at the price at which they were bought.....Anybody may deliver the above mentioned materials to the Rua Nova do Arsenal where their right price will be paid and where also these materials will be sold at the right price to those who need them, in small or large quantities, to carry out their building work.*"[6] The reference here is to materials, but the Portuguese word for materials' would not exclude manufactured components any more than would the English word.

A search has been made for documents contemporary with the rebuilding which would confirm the oral tradition about prefabrication and the effect of the government measures described above. Unfortunately many documents have been destroyed by a recent fire in the main Lisbon archives, but 13 building contracts have been found dating from between 1757 and 1777, which places them all within the period of the rebuilding of the Pombaline quarter[7] Two of these include specific mention of building dimensions, materials and components, and English translations are included here as Appendices 2 and 3. In ten out of the 13 contracts (contracts nos. 1-3, 5, 6, and 8-12) the contractor is a master mason with responsibility for at least masonry and carpentry, and in some cases for other trades also. In only one of the 13 contracts (no. 4) is carpentry specifically excluded. In the contracts translated and given in the Appendices, a master mason is effectively the general contractor, with responsibility for "all the works" including masonry, carpentry, joinery, ironmongery and "finishing" (presumably plastering and painting) in the 1760 contract (Appendix 2), and for masonry, carpentry, joinery, ironmongery, roof tiling and glazing in the 1776 contract (Appendix 3). In both contracts, payment is to be in relatively large, infrequent instalments, with most of the payment being towards or at the end of the construction process in the 1760 contract. In another four of the contracts found (contracts nos. 3, 6, 9, and 13) there is provision for half or more of the payment to be made on or after completion, and in three of these cases, some or all of the payment is to be made from the rents of the completed buildings (contracts nos. 6, 19, and 13).

The contract sum for the 1760 contract is 144,000 Reis (Appendix 2). For the 1776 contract it is not clear, but it is probably 48,000 Reis. The values of other contracts found are 840,000 Reis, 467,000 Reis and 760,000 Reis (contracts nos. 1, 2, and 6). An indication of these values in terms of modern currency can be given by comparing them with salaries paid at the time. In 1760, salaries at the Real Herário Hospital in Lisbon were as follows:[8]

Director	500,000 Reis per annum
First Doctor	150,000 Reis per annum
Second Doctor	50,000 Reis per annum
Surgeon	100,000 Reis per annum
Nurse	42,000 Reis per annum

Taking these salaries as a guide, and bearing in mind that relative values of goods and services in eighteenth century Portugal would have been quite different from those of modern Britain, it can nevertheless be seen that one Rei in 1760 was worth approximately 50p in modern UK currency. Hence the values of the contracts found range from about £24,000 to £420,000.

A picture emerges of master masons, acting as general contractors, who were not merely self-employed tradesmen Rather, they were businessmen who were expected to organise substantial building operations including most of the principal trades, and to raise substantial amounts of capital; more so even than many general contractors at present in the UK, where stage payments under most contracts are far more frequent than in the eighteenth century Portuguese contracts Although none of the contracts found has been positively identified as relating to the Pombaline quarter itself, it is reasonable to suppose that the contractual arrangements indicated were typical of the period and that similar arrangements would have applied to the quarter. In view of this it would not be altogether surprising to find that the contractors were expected to obtain prefabricated, mass-produced components from already existing stock. Both contracts translated in the Appendices include further evidence suggesting that this was the case. They both give dimensions in palms': the palm is an anthropometrically derived unit of measurement, being 225mm or the distance from the tip of the thumb to the tip of the little finger on the outstretched hand. In both contracts door and window opening sizes are given as whole numbers of palms, and in the 1760 contract (Appendix 2) it is stated that the stonework for the stairs, and the dormer windows must come from the Stock Exchange of the Terreiro do Paço.

The Rua Nova do Arsenal leads from the Terreiro do Paço, and hence it seems highly likely that the "Stock Exchange" referred to is in fact the stockpile of building materials established by the Treasury as a result of the edict of 1757, just over three years before the date of the 1760 contract. If this is so then the stockpile contained prefabricated components such as windows and stonework for staircases, perhaps stone treads, and the incorporation of these components was facilitated by dimensional co-ordination based on the module of the palm.

It may be considered strange that only the dormer windows in the 1760 contract were to be obtained from the Treasury stockpile, not the other windows. The reason for this may be that the other windows were to have semicircular arches over them, unlike those of the buildings in the Pombaline quarter itself, and hence would have to be purpose-made.

The site of the building referred to in the 1760 contract has not been identified, but the description of the semicircular arches indicates that it was not in the Pombaline Quarter itself Neither was the building referred to in the 1776 contract, but the latter was close to the Pombaline quarter in an area where the design of the existing eighteenth century buildings is very similar to those of the Pombaline quarter itself. If prefabricated, mass-produced components from already existing stocks were being used for buildings outside the quarter, then it seems even more likely that they were used inside where the design of the buildings is yet further repetitive and standardised.

The idea of using prefabrication for the rebuilding of Lisbon is thought to have come from wooden huts which were imported from Holland immediately after the earthquake, to provide temporary accommodation for the inhabitants whose homes had been destroyed. França refers to contemporary British accounts of the earthquake, which state that the hut components were sent by sea and could be erected in twenty four hours, and dismantled and re-erected just as quickly.[9]

The Pombaline buildings were not completely prefabricated – they included, for example, substantial amounts of rubble stone walling - but they did incorporate many standardised and possibly prefabricated components, especially dressed stone and joinery items, the use of which relied on effective dimensional co-ordination. These components did not differ radically from those which were already produced by craftsmen to order, and which can be seen in surviving buildings from before the earthquake, such as Ludovice House. They were merely simplified and

standardised in a way which would have accelerated their manufacture by mass production. They could then have been produced in an anonymous and abstract way in workshop scattered through the outskirts of the city as well as within it. Few workshops or factories from the period remain, except for a wall tile factory at Amoreiras, the *Fabrica do Rato*, which is believed to have produced many of the ceramic wall tiles which were used in the reconstruction.[10]

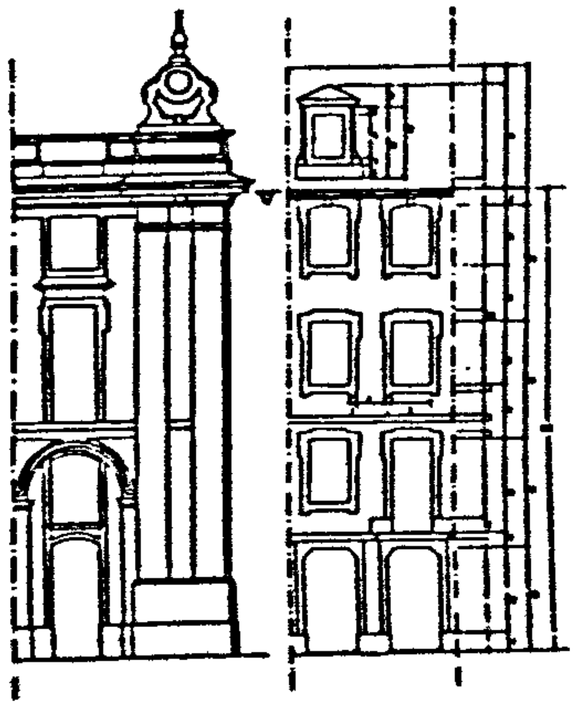


Fig 5: The palm used in the composition of the façades. (Drawing by Jorge Mascarenhas).

Dimensional Co-ordination at Urban Planning Level

Given the densely built up nature of the Pombaline quarter, modular design at individual building level would have been difficult without a rectilinear urban plan. It can be shown that the urban plan was based on the Golden Rectangle consisting of a series of rectangular blocks of buildings bounded on all four sides by streets with a narrow courtyard or *alfugere* in the centre of each block to light the rooms at the rear of the buildings (Fig. 2). Almost every elevation of every block was drawn by da Maia's team and these drawings survive.[11] The design of the elevations is based on the palm, like that of the buildings referred to in the contracts discussed above. The heights on the elevations of the rentable buildings in the Pombaline quarter are aligned with the heights on the elevations of the public buildings in the *Praça do Comércio* (Fig. 5) and the dimensions of window and door openings, their dressed stone surrounds and the space between them are all exact numbers of palms. Thus in general the overall lengths and widths of the blocks of buildings are also exact numbers of palms, and must have been determined by the design of the elevations.

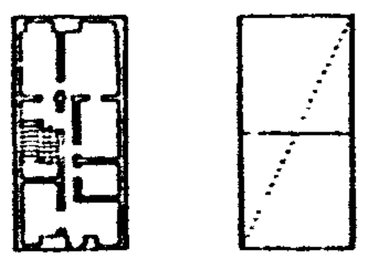


Fig 6a: Plan of a two-window façade width building: double square: 177 Correiros Street. (Drawing by Jorge Mascarenhas).

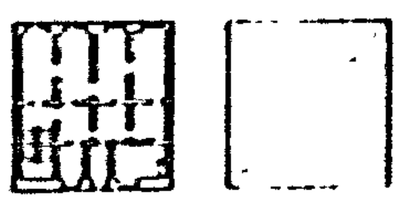


Fig 6b: Plan of a four-window façade width building: square: 187 Prata Street. (Drawing by Jorge Mascarenhas).

The blocks are divided into individual buildings of various sizes, each size having a different number of windows across the width of the street façade. In many of the blocks, the two-window façade width building is a double square in plan (Fig. 6a) and the four-window façade width building is a square (Fig. 6b). No particular proportion can be satisfactorily applied to the three- and five- window façade width buildings of the same depth; this is not surprising since the same window widths and spacings are used and these, together with the plan depth determine the overall plan dimensions of the building.

Dimension Co-Ordination in the Internal Planning of the Buildings

No original drawings are known to have survived showing the internal planning of any of the rentable buildings in the Pombaline quarter, and it is not known who designed the internal layouts. It is clear, however, from da Maia's dissertations that individual owners were responsible for the actual construction of the buildings, so it can be presumed that they were also responsible for determining the internal layouts.[12] They may have had help from architects in doing this; indeed there may even have been private arrangements between building owners and members of da Maia's team; a drawing by Carlos Mardel, one of the team, of the internal layout of a comparable building elsewhere in Portugal has survived.[13]

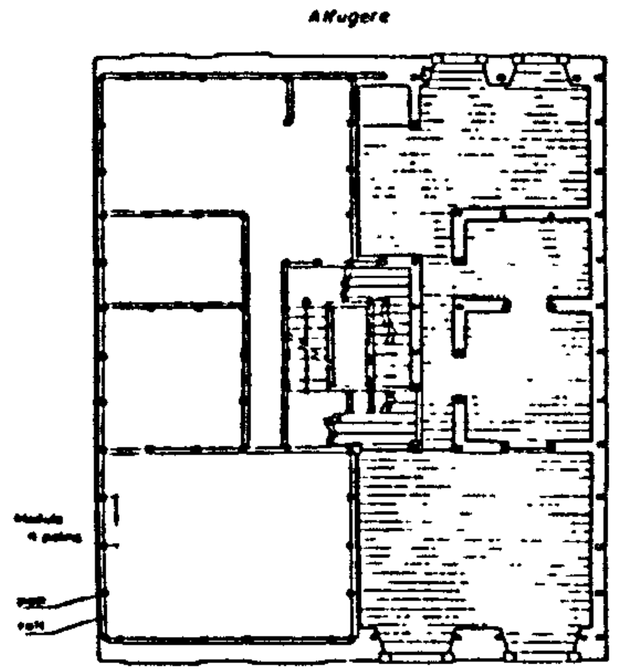


Fig 7: Modular Planning. Floor plan of no 75 Conceição Street. (Drawing by Jorge Mascarenhas).

Apart from the overall size of the building and the pre-designed street elevations, the other main constraint on the internal layout was the gaiola or timber frame structure, the incorporation of which was a requirement.[14] It is known that a prototype *gaiola* was built and tested by da Maia's team[15] and so it is to be expected that the design of *gaiolas* in individual buildings would be closely controlled. The *gaiola* is not normally exposed, but three examples have been recorded in detail during recent internal alterations to buildings, at no. 75 Conceição Street, no. 110 São Nicolau Street and no. 60 Ouro Street.

In the plan of no. 75 Conceição Street (Fig. 7), 900mm, a multiple of the palm, is normally the distance between the centre of the studs in the *gaiola*. However the module is varied to accommodate both the stairwell and the windows, and the overall width of the *gaiola* of this building is not a multiple of 900mm.

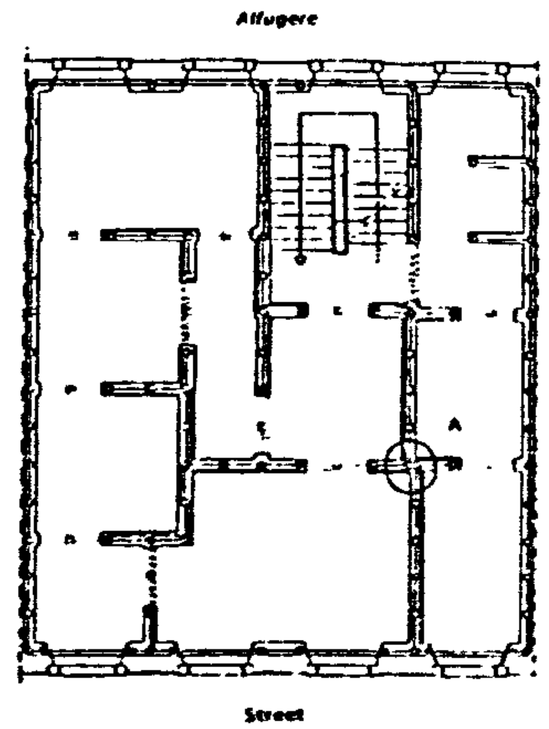


Fig 8: A variant of the module: Floor plan of no 110 São Nicolau Street. (Drawing by Jorge Mascarenhas).

The floorplan of no. 110 São Nicolau Street is illustrated in Figure 8. At first sight this appears to show a more consistent use of modular planning. However the basic module is no longer an exact multiple of the palm, being 831mm, and at point A' on the plan the post is doubled up, making the overall plan width of the gaiola of this building exceed an exact multiple

of the basic module by the thickness of the extra post. Here the module is not varied to accommodate the windows; instead the members of the gaiola which would obstruct the windows are merely left out.

Both no. 75 Conceição Street and no. 110 São Nicolau Street have *gaiolas* with plan depths equal to an exact number of modules, but a different module in each case. In spite of this the plan depths, and indeed the widths of the two buildings, are identical to within 100mm.

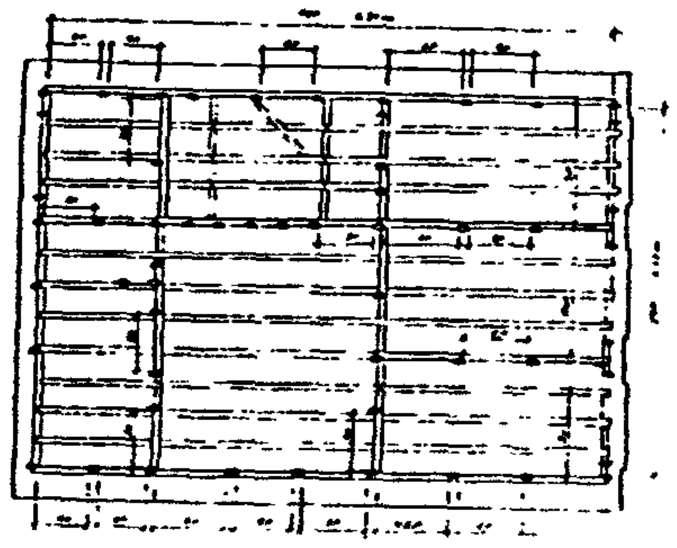


Fig 9: Planning on a 'tartan' grid. Floor plan of no. 60 Ouro Street. (Drawing by Jorge Mascarenhas).

In the third recorded example of the *gaiola*, no. 60 Ouro Street (Fig. 9), the palm again appears to be the dimensional basis of its design in plan, but this time the module of four palms or 900mm is the space between the posts of the gaiola, not the distance between their centres; it is planned on a 'tartan' grid. Moreover, distances of five palms (1125mm) and six plans (1350mm) are also found, and as in no. 75 Conceição Street the modular planning, such as it is, is varied to accommodate the stairwell and windows.

Hence the evidence from these three examples is that the design of the *gaiola*, although to some extent modular, was fitted imperfectly into the space available; if the overall design of the blocks of the buildings and their elevations was intended to allow for a perfectly modular *gaiola*, it was not successful in this.

It seems more likely that this was never the intention. The joints between members of the *gaiolas* are typically lapped, halved or lapped and dovetailed (Fig. 10); there are no carpenters' marks so the joints are unlikely to have been prefabricated, although the timbers may have been cut approximately to length before being sent to site. Other than doors, windows and their dressed stone surrounds, and possibly staircases, no other prefabricated components were dependent on the dimensional accuracy of the *gaiola*. Therefore, provided that the components listed above could be accommodated, that the design of the elevations was respected and that the *gaiolas* were sufficiently similar to the prototypes to be adequate structurally, no problems would have been caused by dimensional irregularities in them.

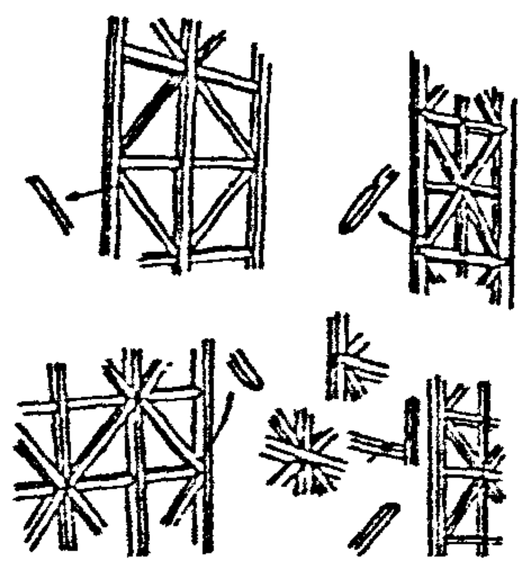
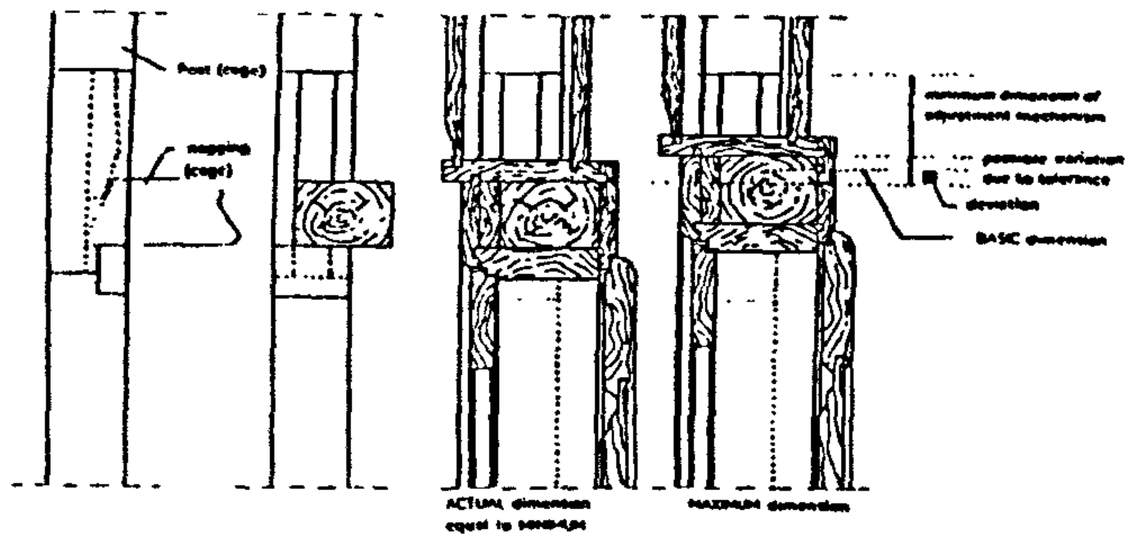


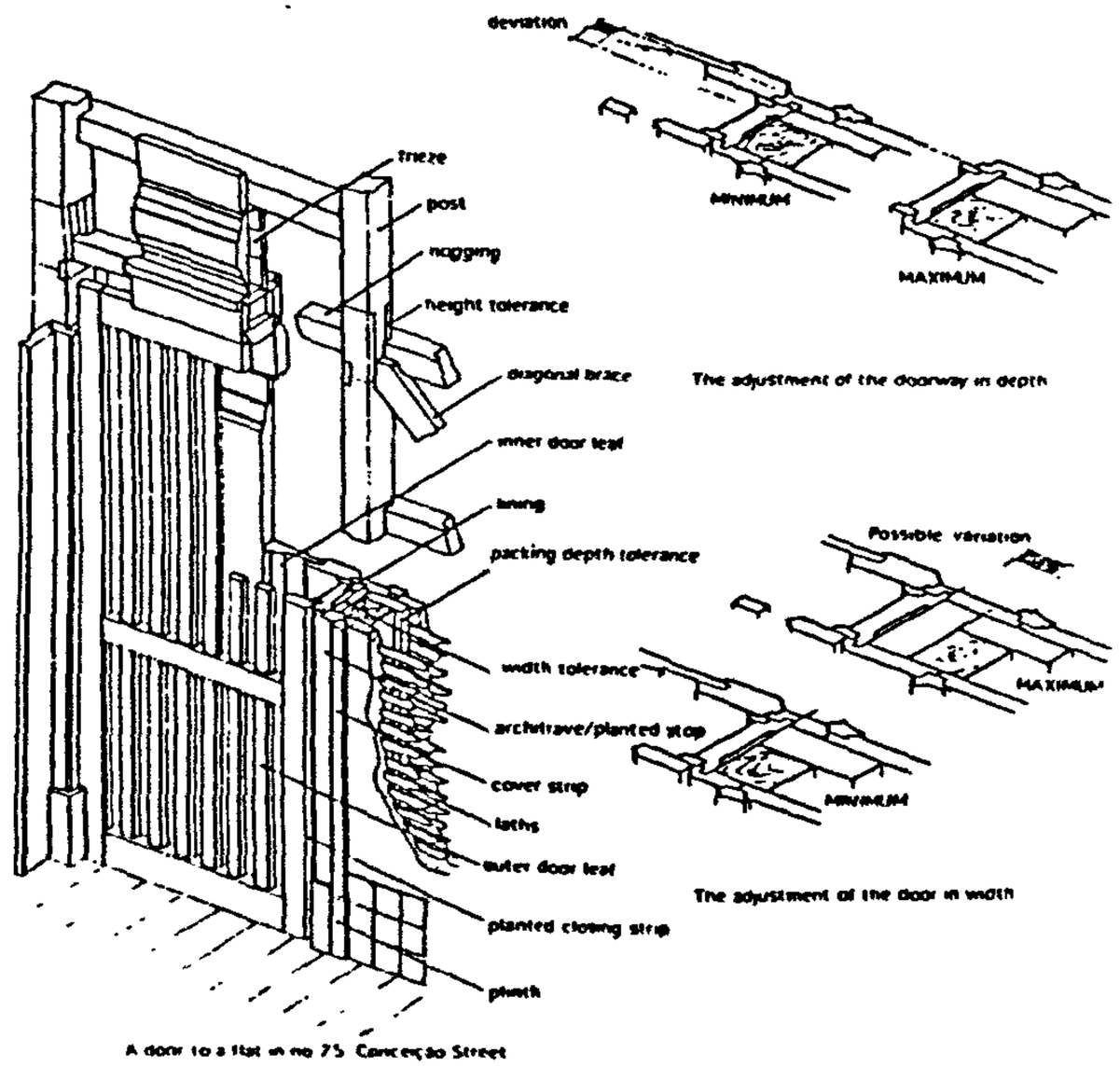
Fig 10: Typical connections between the members of the gaiola. (Drawing by Jorge Mascarenhas).

Tolerances

An essential characteristic of any building design based on dimensional co-ordination and prefabrication of components is the



The adjustment of the door in height



The adjustment of the doorway in depth

The adjustment of the door in width

A door to a flat in no 75 Conceição Street

Fig 11: Tolerances: A door to a flat in no 75 Conceição Street. (Drawing by Jorge Mascarenhas).

inclusion of manufacturing tolerances for the components. Even a perfect manufacturing process is governed by the accuracy of measuring instruments, and in eighteenth century Portugal measurement of dimensions is almost certain to have been less consistent than it is today. It will be no surprise, therefore, to find that substantial manufacturing tolerances were built into the design and construction of the Pombaline buildings. The component chosen to illustrate these tolerances is one of three doors at the entrance to a flat in no. 75 Conceição Street.

The detailing of the doorway allows for adjustment of the thickness of the partition, the width of the door leaves and the height of the door leaves. The thickness of the partition, and therefore also the width of the door lining, is adjusted by varying the thickness of packing pieces which are planted on the face of the post in the gaiola next to the doorway, to bring it flush with the face of the nogging over the doorway which is lapped over the posts on either side (Fig. 11). The thickness of these packing pieces could be varied by as much as 10mm above and below the norm.

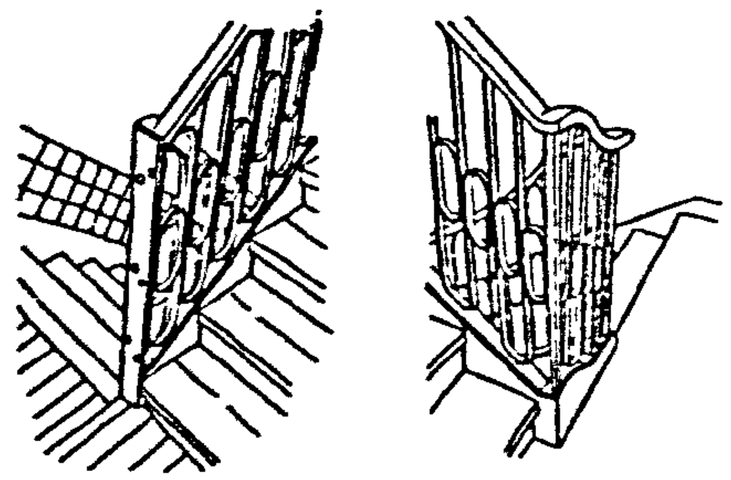


Fig 12: Site assembly of prefabricated components: wrought iron staircase balustrade at no. 56 Assunção Street. (Drawing by Jorge Mascarenhas).

The width of the door leaves, or strictly speaking of the space occupied by the door leaves, is adjusted by packing pieces planted on the doorway face of the *gaiola* post, which pack out the door lining. These packing pieces can vary in thickness from nil to 100mm (Fig. 12). Both this variation and the variation in thickness of the packing pieces described above could be used to accommodate inaccuracies in the construction of the *gaiola* itself and as well as variation in the widths of door linings and door leaves. However, the mechanism for adjusting the height of the door leaves involves altering a dimension of the *gaiola* itself and its presence can only be explained by substantial variations in the heights of mass-produced door leaves obtained as standard components from stock.

The dimension of the *gaiola* which is altered is the height of the nogging which forms the head of the structural opening for the doors. The alteration is effected by varying the size of wooden inserts which fit into recesses in the *gaiola* posts on either side of he doorway. By this means the height of the door leaves can be varied by up to 20mm above and below the norm. This is greater than the variation which we would expect in mass-produced standardised door leaves today, but this is probably due to inconsistencies in measuring instruments used in eighteenth century Portugal, together with the large number of small workshops from which the door leaves would have been obtained.

No documentary evidence has been found to show that door leaves in the rentable buildings in the Pombaline quarter were prefabricated, but it is known that at the time of the rebuilding door leaves manufactured in Lisbon were sent by sea to be incorporated in buildings elsewhere in Portugal.[16] Together with the physical evidence of tolerances discussed above, this provides a strong case for the proposition that the door leaves were prefabricated and mass-produced in much the same way that they are today, though without the mechanisation of the production process.

Site Assembly of Prefabricated Components

When prefabrication of building components is employed special provision sometimes has to be made for assembling and fixing them on site. In the Pombaline rentable buildings this was the case with the staircase balustrades, examples of which are illustrated in Figure 13. The running track' shaped wrought iron components of the balustrades are screwed together on site, and they can easily be adapted to any pitch of staircase. This is further evidence to suggest that components were mass-produced with no particular building in mind, and then obtained ex-stock' when they were required.

Conclusion

Clearly the architects of the Pombaline quarter did not achieve the extent of dimensional co-ordination that is present in some late twentieth century buildings, and they did not need to, for the extent of prefabrication is not as great. Nevertheless the documentary and physical evidence discussed above all suggest that the standardisation of huge numbers of windows, doors and their associated dressed stone lintels, jambs and sills enabled their prefabrication, mass-production and supply from stock when required, and that ceramic wall tiles and wrought iron staircase balustrade components were also produced and supplied in this way.

This standardisation of components and the associated standardisation of the design of the buildings into which they were incorporated, on such a large scale is, to say the least, unusual for the eighteenth century, and surely deserves international recognition. Such recognition now seems imminent with a proposal having been made to designate the Pombaline quarter as a World Heritage site; it is to be hoped that this proposal will be realised as soon as possible, since although the exteriors of the Pombaline buildings are already protected by law, their interiors and therefore much of their unique construction are not, and many of them have already been altered beyond recognition.

Appendix 1

Translation of Letter from Antonio Pardal Monteiro

"Dear Colleague,
Concerning your question, I do not know anything about any bibliographical research made by my uncle Porfirio Pardal Monteiro.

My knowledge about him comes from my family, and especially from the fact that he had worked with me for many years, which leads me to think that what he said is a result of experimental knowledge of the subject.

In fact, I know that he dedicated himself to the detailed study of Pombaline construction, which was readily done through the interventions he undertook in some of the buildings.

In another way, the contact with generations of stoneworkers (including his father, who worked at the end of the nineteenth century) could be his basis for the information, because these tradesmen recounted events from before their time, which could I believe be related to the supply of the masonry work for the reconstruction of Lisbon.

I have heard from my grandfather, among others, detailed descriptions related to the transportation of monolithic columns destined for the Convent of Mafra, which do not exactly coincide with those of José Saramago in his "Memorial of the Convent", but fully agree on the essential points. The reconstruction of Lisbon was undertaken later, so the memories of it are more alive.

Whilst not excluding the possibility of a documentary survey, these reasons lead me to believe that his main source of information could be the memories of previous generations and the exhaustive work of analysing buildings."

Appendix 2

1760 Building Contract

From the Indice das Escrituras de Outobro de 1757 até Janeiro de 1790, Notário Tavares de Carvalho, Livro 8, Caixa 2, no. 91, Agosto de 1760, Arquivo Nacional da Torre do Tombo, Lisbon.

"In the name of God, Amen. For the knowledge of all this instrument of building contract the subscribers put themselves under obligation, on the 4th day of August in the year of our Lord Jesus Christ 1760, in the City of Lisbon, St Lourdes Street, parish of....at my office being present, of the one part João Batista Terrabufe, conservator of Your Majesty, resident in Casas do Chito courtyard, in the place of Algolana of Belém, and the other Jacinto Peires, mason, living in front of Sapato Bay on the land side, it was agreed by me, notary and by the witnesses whose names are hereunder mentioned, that we subscribe the contract in which he, Jacinto Peires in a property of houses belonging to His Majesty, (on the land side), which is situated between the properties of the Marquis of Angoja to the North measuring 28 palms and 40 palms at the bottom on which he intends to build shops and flats with hipped roofs, under which contract the master subscribes to build the aforementioned buildings on the following conditions, without any delay, undertaking the hallowed art of his office as mason as necessary, having in mind to return the buildings to João Batista strictly as follows: first, on the ground floor the shop is to have a door of six palms width and ten in height with an arch over, and another door to the stair of four palms width and 8.5 in height with an arch over, with a step and a window with a round arch of 6 palms width. On the first floor will be a french window of twelve palms height and 6 width, two windows with half-circle arches with four panes one palm each wide and six in height. The stonework from the stairs must be from the stock exchange of the Terreiro do Paço, as the dormer windows must be from the Terreiro do Paço, with the exposed surfaces limewashed. The first floor beams must be squared, the thickest ones must be used for the attic. The other beams and the softwood for the floors must also be taken from the Terreiro do Paço, and the floor boards must be carefully planed on their faces, also the beams and boards used in the roof structure must be in softwood with the eaves of the roof to be *mouriscado* (corbelled and sprocketed) with good tiles. All iron fixtures must be paid for by the builder with the exception of one item of ironwork which will be paid for by the owner because he intends it to be ornamental to his requirements. The same arrangement will apply to the materials for the fireplaces.

The wood used for floors and ceilings must be the same as that used for windows, and the same for the stairs. On this contract the owner must provide the necessary water

The Contract Sum of 144 thousand Reis will be paid as follows:

In November the owner will finance a fund to be used during a calendar year.

One thousand Reis for the cost of the shops.

Sixty six thousand Reis on commencement of occupation of the flats.

The remainder of the 144 thousand Reis when the three flats have been completed.

All the works including the finishing are included in the 144 thousand Reis and there shall be no departure from the contract sum after payment has been made.

All lime, stone, wood and iron fixtures will be included in the payments with the exception of the water. The total agreed payment as stated above will not be exceeded."

Appendix 3

Translation of the 1776 Building Contract

From the Indice das Escrituras de Outobro de 1757 até Janeiro de 1790, Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, no 55, May 1776, Arquivo Nacional do Torre do Tombo, Lisbon.

"To the knowledge of everyone obligated in this building contract, established on the second of May in the year of our Lord Jesus Christ 1776, in this city of Lisbon, in Broad Street of S. Roque, in my office were present his Excellency Caetano de Sousa Coelho as agent (attorney) of his Excellency Mr Antônio de Melo, by the letter of attorney which was resent and previously copied Of the other part Francisco Fernandes Bento, Master Stonemason, who lives on Oliveira Hill Street Parish....

It was stated by Caetano de Sousa Coelho that his client is the owner of houses situated in Carvalho Street in the Parish of Merces adjoining his Palace, which need some repairs in order to be let. For this the stonemason, to make the essential repairs, was contracted as follows:

- The façade wall of the house belonging to the property which is 36.5 palms long, must be demolished, but the floor beams must be replaced and straightened. In the new wall there must be windows 6 palms high and 5 palms wide, taking advantage of the existing arch Another window opening must be formed, facing the back yard.
- On the backyard elevation over the kitchen floor beams at second floor level, a wall must be built with stone and lime 36.5 palms long and palm thick to the height of the roof.
- In this wall three window openings must be formed, 5 palms high and 4 palms wide, assembled on the gaiola of oak or Brazilian wood from dismantled ships.
- The door garrison must be executed in Flanders wood and the panels in soft pine, following a simple pattern with the necessary ironmongery.
- In the case of the front façade the owner must provide all stone needed. The cost of bedding the stones is included in the contract which could compensate for the wood used for the gaiola. Also included is the cost of two glass windows in soft pine 5 palms high and 4 palms wide.
- The owner must provide all necessary masonry starting by the windows.
- The cost of daywork and the sand, lime and tiles (for the roof) needed to repair the buildings is included in the cost of the contract, compensated if any wood is found which can be used in the building.

All wood found which is unsuitable for the repair work is for the builder in order to compensate for the work of dismantling ships in a proportion of one to three.

All rubble must be disposed of in the orange groves and vineyard behind the building

The builder is to lower the roof structure of the second floor kitchen in order to connect it to the new wall throughout its length.

It is necessary to build an internal wall 12 palms long.

It is also necessary to extend the stone doorway at first floor level to a height of 9 palms, with a width of 4 palms, with a door made of wood of the same quality as the windows, namely soft pine, with good ironwork.

In all work the builders must follow the best traditions of their respective trades, with all perfection, safety and commodity, beginning by depositing 1000 Reis without obligation.

Because the owner intends to rent the property to Dom João Ambrósio Bartolomeu, Venetian citizen for a period of eight years and ... months, starting on St John's day with the sum of 33,600 Reis paid or to pay between St John's day and Christmas, with the obligation to pay for the repair

work, and also with the benefit of the other rents or sales, Dom João Ambrósio Bartolomeu is to pay the builder 120,000 Reis. Under this contract 48,000 Reis will be paid. The owner solemnly undertakes to pay the remaining amounts as follows:

- 12,000 Reis when the work is finished
- 70,000 Reis in three instalments
  - On 5th November this year
  - On 5th May 1777
  - On 5th November of the same year (1777)

If Dom João Ambrósio Bartolomeu does not keep his word, all the dwellings will be advertised for rent and he will forfeit all privileges, rental rights and advance payments. To obtain the remaining amount all his properties and belongings would be pledged.

Before the expiry of the agreed 8 year term of the lease the tenant may vacate the property if he can find another tenant willing to pay a higher rent, in which case the owner will receive this amount and pay it to the builder. During this period the tenant is not allowed to undertake any repairs until the total sum due has been paid. On expiry of the 8 year term a new rental contract will be established.

The builder undertakes to complete the works as soon as possible, before St John's day, forfeiting any interest or any increase above the agreed sum, and paying for any damage caused.

It is also necessary to form a window opening in the dining room 5 palms high and 4 palms wide, in the way described above for the other windows. The following are the names of the witnesses...."

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Correspondence

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References

1 José-Augusto França. *Lisboa Pombalina e o Iluminismo*, 3rd edition, (Lisbon, 1983), pp 59-76.
2 Manuel da Maia. *Dissertações*, (Lisbon, 1756), in França, *Lisboa* p314.
3 França, *Lisboa*, p161.
4 França, *Lisboa*, pp 163-5.
5 Montero Pardal. *Of Portugueses Percursores da Arquitectura Moderna e do Urbanismo*, in Museu V. (Oporto, 1983), p12.
6 Ministério da Justiça. *Livra das Intendências* (Collection of Original Documents).
7 All the contracts found are in the Arquivo Nacional da Torre do Tombo, Lisbon, Indice das Escrituras de Outobro de 1757 até Janeiro de 1790. They are listed below in chronological order and numbered for ease of reference.

Contract no. 1. Notário Tavares de Carvalho, Livro 3, Caixa 2, No. 75, May 1757, between Gaspar Teixeira and António Luis.
Contract no. 2. Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, No. 4, June 1759, between José Manuel da Fonseca and the mason Joaquim Madeira.
Contract no. 3 Notário Eugénio Carvalho e Silva, Livro 12, Caixa 3, No 15, June 1759, between José Manuel de Sousa Alves Coutinho and the mason Mateus Luis.
Contract no. 4. Notário Tavares de Carvalho, Livro 8, Caixa 2, No. 85, May 1760, between Giraldo Roiz da Fonseca and Felipe Caetano.
Contract no. 5. Notário Tavares de Carvalho, Livro 8, Caixa 2, No. 91, August 1760, between João Batista Terrabufe and Jacinto Peires.
Contract no. 6. Notário Tavares de Carvalho, Livro 9, Caixa 2, No. 87, January 1761, between João Batista Terrabufe and Jacinto Pereira.
Contract no. 7. Notário Tavares de Carvalho, Livro 10, Caixa 2, No. 74, June 1761, between Francisco António Vasconceios and Luis da Cunha e Castro.
Contract no. 8. Notário Tavares de Carvalho, Livro 18, Caixa 4, No 26, February 1766, between Francisco António Vieira and Manuel Luis António Sousa.
Contract no. 9. Notário Tavares de Carvalho, Cartório 4, Livro 18, Caixa 4, No 23, May 1766, between António Monteiro Godinho and Francisco José Fonseca da Silva.
Contract no. 10 Notário Eugénio Carvalho e Silva, Livro 47, Caixa 5, August 1766, between Cipriano Joaquim António and others.
Contract no. 11. Notário Eugénio Carvalho e Silva, Livro 34, Caixa 7, No 35, March 1771, between Dom Henrique da Silva and others.
Contract no. 12. Notário Eugénio Carvalho e Silva, Livro 46, Caixa 5, May 1776, between António de Melo and the mason Francisco Fernandes Bento.
Contract no. 13. Notário Eugénio Carvalho e Silva, Livro 49, Caixa 10, No. 13, April 1777, between António Pedro and the master Manuel dos Santos Torres.

8 Joaquim Verissimo Serrão. *História de Portugal. Vol. VI. 1750-1807*, (Lisbon, 1982), p274.
9 França. *Lisboa*, p 165.
10 França. *Lisboa*, p 165.
11 França. *Lisboa*, pp 108-14, 116-9, 131-3, 136, 169, 175.
12 da Maia. *Dissertações*, pp 320-6.
13 José-Augusto França. *A Reconstrução de Lisboa e a Arquitectura Pombalina*, Vol 12, 3rd edition, (Lisbon, 1989), pp 54-5.
14 França. *Reconstrução*, p 56.
15 França. *Reconstrução*, p 57.
16 Horta Correia, José Eduardo, Vila Real de Santo Antonio / Urbanismo e Poder na Politica Pombalina, Ph D Thesis, Universidade Nova da Lisboa, 1984., pp 52-60, XXI, LXXIX.